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REPORT

ON THE

PROGRESS OF PHYSIOLOGICAL BOTANY

DURING THE YEAR 1841.

BY

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REPORT

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PROGRESS OF PHYSIOLOGICAL BOTANY, &c.

Annual Reports on the progress made in science, as first instituted by Berzelius for Chemistry and Physics, rank among the most useful of our scientific arrangements, provided three conditions are borne in mind. First of all, they must not be published too late, when the information is already known to the public, and, therefore, superfluous; and if such should be the case with the present Annual Report, let it be considered, that the unexpected death of the former reporter, Professor Meyen, occasioned an unavoidable delay. It is always better to make up, in individual matters, than to publish all too late. The second condition is, to give, as far as possible, a faithful report of the statements of the author, without mingling them with the opinions of others. It appears also preferable to me, to pass over a work entirely, rather than to pronounce it at once as insignificant. It is at times necessary to introduce the author verbally, in order to exhibit the manner in which he has instituted his observations. But this is not always practicable, and it is frequently very difficult to represent the views of another faithfully, because many authors have not the ability to express themselves in definite, and therefore in distinct terms, a deficiency which particularly betrays itself by the use of too many words, used in order to avoid the necessity of stating, that they are not yet acquainted with a certain matter, or that they have committed an error, or that they have not yet a distinct view of the subject. The more inexperienced we are in a science, the more apt are we to suppose ourselves perfect in it, and the less are we inclined to confess that we have been mistaken. Finally, it is unsuitable to make controversy a principal object of an annual report, or to conduct it in an irritable and hostile spirit, or to quarrel and dispute, when nothing can be said against the principal matter. The Anatomy and Physiology of Plants has been very much exposed to such contentions, and a progress of their knowledge has been rather impeded than facilitated by them. My predecessor in this work, can, by no means, be absolved from the reproach of a contentious disposition; I shall, however, endeavour to avoid imitating him in that respect.

INTERNAL STRUCTURE OF PLANTS.

We find a treatise on *the Internal Structure of Plants in general*, in the *Annales des Sciences Naturelles*, second series, volume xiv. p. 16, 17, under the title of—" Etudes Phytologiques, par le Comte de Tristan. Prem. Mem. de la Nature des tissus Végétaux." The author commences with the question, whether the tissue of vegetables is homogeneous or not. With this view he contemplates the transverse section of the stem of any plant—for instance of the Poppy (*Papaver somniferum*); and further, of the petiole of the leaf, as of *Cucurbita maxima*, and finds therein a double tissue. The first occupies the greatest part of the stem or petiole, and clearly consists of cells; the second surrounds the vascular bundles. The latter, however, do not always exist, but the tissue also occurs without them. He now follows the fine fibres of the latter, as far as the ovarium, and finds, that it only exhibits itself there in bright spots, in which no organization is perceptible. Spiral vessels are only subsequently produced in the axis of these fibres. The " clear" unorganized substance he terms cambium, and says of it, that it may have exuded from the first tissue, but that it is not homogeneous with it. In this respect he distinguishes the second tissue from the first; and since the cells of this first tissue resemble foam, being only more consistent, he terms the first tissue " aphrostase;" the second, because it accompanies, and, as it were, conducts the vessels, " hegemon." A division, or fissure, which he calls " cunice," separates, in trees, the bark from the internal part, or from the " endophyte" as he terms it. The inner part, however, does not consist of a single part, but of the pith, and that which is called wood, but which does not always deserve this name, as it is frequently very soft in herbs. The author therefore terms it " endostere," because it is at all events firmer than the surrounding part. He now proceeds to examine the origin of the so-termed " prolongemens medullaires," and says of them, that they originate from the " tissue aphrostasien," that they also continually get smaller, and that the vascular bundles which have grown up, thicken, at last only leaving a trace of them. He therefore terms them " isthmes aphrostasien," or briefly " isthmes." The consideration of a transverse section in the stem of a bramble (*Rubus fruticosus*) leads him to the adoption of a third tissue, which he terms " proxyle," distinguishing it by the circumstance, that it consists of prismatic or cylindrical fibres (filets) of an indefinite length. He examines it from its first origin, and finds that it also consists at first of a cambium, so that each of the three tissues has its own peculiar cambium. These tissues are very often intermixed, and he terms such a mixture, which is produced from an effusion of the cambium " proxylaire," into another already formed tissue, an " adelome." These are the principal contents of the treatise.

It is gratifying to see, how an observer, without regarding that which others have done before him, nevertheless hits upon the best arrangement. The three kinds of cellular tissue, as determined by the author, certainly deserve to be distinguished. The first is that cellular tissue (called " *aphrostases*" by the author), which constitutes the basis of the whole stem, or rather of the whole plant, and which always consists of parenchyma, and is forced together in the stem by means of the growing woody bundles (holz-bündel); and medullary rays (*prolongemens medullaires*) are formed, which the author very correctly defines, and not unjustly terms, " isthmes." The general term " hegemon," for the cellular tissue, which accompanies the vascular bundles, and which mostly consists of parenchyma—at times, also, however, of long, narrow, parenchymatous cells—is likewise very proper. The third cellular tissue of the author, the " proxyle," has already received the name of liber. The Greek appellations of the author are, however, bad enough, — " Aphrostase" means position of foam; " hegemon," a leader; " proxyle," anterior wood; " adelome," concealment. The French always used to ridicule the technical terms of our learned men as proofs of their pedantry; we might now, I think, justly return the compliment. In German, we might term these tissues Grund-gewebe (fundamental tissue); Begleitendes-gewebe (accompanying tissue); and Bast-gewebe (liber tissue.) That the author only saw an inorganic matter in the so-termed cambium, probably was owing to employing too low a magnifying power

With this I beg to combine the announcement of a treatise, which struck me very much, and which partially belongs to this subject:—" Etude Microscopique des Précipités et de leurs Métamorphoses appliquée à l'explication de divers Phénomenés Physiques et Physiologiques, par P. Harting. V. Bulletin des Sciences Physiques et Naturelles en Neerlande. Ann. 1840, p. 287, 365." The author has analyzed a number of precipitates, formed mostly with inorganic substances alone, very few of them with organic and inorganic substances together. The first kind of precipitates, according to our author, are the *crystalline;* and he asserts, that crystallization is an original act. The second kind are the *moleculary.* Their form cannot be ascertained, because the corners or angles, in the small granules, cannot be recognised beyond a certain boundary. The granules unite themselves to irregular or flocculent masses, and the molecular motion ceases as soon as this is effected. The third kind, the *membranous* precipitates, are in many instances produced immediately; at first they are flexible, become, however, brittle afterwards, and are changed also into flocculent masses. The fourth and last kind, are the *gelatinous* precipitates. Thus far the subject, properly speaking, does not belong to our department. The author, however, proceeds further. He reduces the molecular movement to an attractive and repelling power, and applies this to the movement of the granules in the cells, which he says may be explained in the same manner, even though it is assumed that the movement depends on the walls of the cells. He refers to the statement of Schwann, with regard to the manner in which the cellular bodies arrange themselves around a granule, and finds a similarity in the manner in which the granules form themselves in the precipitates. He carbonized pieces of an onion, the cells of which contained nuclei, and found the nucleus destroyed; but is still of opinion, however, that this negative result does not prove any thing. Carbonized parts of plants, it is well known, retain their original form, and the author therefore inquires, whether the formation of the homogeneous organic members may not be considered as a membranous precipitate of substances, which are usually termed inorganic.

In the present year (1841) I have published a small treatise respecting the solidity of bodies, with the view of directing the attention of natural philosophers to this subject. I have seen, and proved it to several eminent natural philosophers, that all precipitates, when analyzed immediately after their formation, exhibit globules; that these globules unite themselves to larger ones (being therefore fluid, like globules of quicksilver); and that these united globules or drops, subsequently only (and that frequently under our own eyes) change themselves into crystals. If M. Harting did not observe this, it was owing to his not having examined the precipitates speedily enough. The globules sometimes form flat surfaces, sometimes they are gelatinous. I have repeated, in this small treatise, what I have before stated, that all fluid substances exhibit a commencement of solidity on their surface — for we attribute fluidity to a substance, if the parts can be displaced from each other by the slightest application of force; and this can only be done, when the attracting and repelling powers of the homogeneous parts neutralize each other, which cannot be the case on the surface of fluid substances, where the parts are unequally drawn in different directions. This solidity increases with the surface, and a thin stratum of fluidity is consequently in itself solid. The degree of solidity certainly depends on the degree of attraction among the parts, which, as is well known, is different also in fluid substances, as exhibited by quicksilver and water. Nothing, therefore, is required, for the production of a membrane, but the separation of a stratum of fluidity, as every bubble shows. The half fluid substances, mucus, jelly, &c., are a mixture of solid and fluid parts, as can be seen when they are dried, and it is saying nothing, to say we have derived a solid substance from mucus. Nor is it by any means necessary, that a fluid substance should have to pass through a state of half fluidity, in order to become solid—as a proof of which, we may adduce the crystals of salt. If we admit attracting and repelling powers to act at pleasure, as M. Harting has done, a good deal may certainly be explained; but we must divest our explanation, as much as possible, of arbitrary assumptions.

We have received many researches this year respecting *the chemical constitution of cellular tissue. First,* Some observations respecting the colouring blue of the vegetable cell-membrane, through means of *iodine*, by Hugo Mohl. Flora, 1840, p. 609. In consequence of Schleiden's observations, the author instituted researches regarding the embryo of *Schotia speciosa.* This embryo swells by a lengthened maceration in cold water, and by boiling with water, but is not entirely dissolved; and then, not only are the cells coloured blue by the application of iodine, but also the mucus around them. The cells of the cotyledons of *Tropeolum majus, hybridum,* and *minus,* exhibit a similar reaction. The blue colour with them, however, does not appear immediately, but the cell-membrane first turns yellow, then green, and finally blue. The cell-membrane of many lichens was likewise analyzed, after Meyen's suggestion, and a similar reaction was observed. The effect upon the *Algæ* was much slighter, and only *Sphærococcus ciliatus*, *Ulva linza*, and *U. lactuca*, assume a blue colour. The author further instituted researches respecting the horn-like albumen-cells; *first*, of those of *Monocotyledons*, when he found the four following principal modifications:—*a.* Albumen-cells, which are coloured yellow by diluted tincture of iodine, becoming yellowish-brown upon being dried, and which assume their former yellow colour again on being moistened, and which, in fact, behave themselves in quite the same manner as the common woody tissue. This takes place, as far as the author investigated, with the albumen of all Palms, for instance, with *Rhapis acaulis*, *Manicaria saccifera*, &c. *b.* Albumen-cells, which exhibit first a yellow, subsequently a brown colour with an admixture of violet, upon the action of iodine, which become clearer or darker yellow-brown upon being dried; and upon being soaked again, become violet, with a brown admixture; as *Iris pratensis*, *atomaria*, *Allium globosum*, *odorum*, *sibiricum*, *Asphodelus luteus*, *Anthericum ramosum*, *Czackia liliastrum*, *Eucomis punctata*. *c.* Albumen-cells, which, upon the action of iodine, become first yellow, then brown, finally dirty violet; when dried, red-brown; when soaked again, violet, with a partial transition to deep violet blue; as *Iris aurea*, *Asparagus dauricus*, *maritimus*, *Scilla peruviana*, *Hyacinthus romanus*, *amethystinus*, *Lilium bulbiferum*, *Tigridia pavonia*, *Convallaria racemosa*, *Yucca gloriosa*. *d.* Albumen-cells, which, by the application of iodine, are coloured with a lively violet; when dry, red brown; soaked again, beautifully violet or deep violet blue. *Ixia hyalina*, *squalida*, *Gladiolus tristis*, *Ruscus racemosus*, *Veltheimia viridifolia*. The author has investigated, with less care, the seed of *Dicotyledons* with horn-like albumen, because the phenomena, as far as he observed them, were the same as in the *Monocotyledonous* plants. Caustic potass acts, according to the author, veryconsiderably upon those albumen-cells which become coloured blue by the application of iodine. Those upon which the alkali acted most slightly, were furnished with considerably thicker walls. It was distinctly seen, that the external strata of each cell were first loosened into a gelatinous mass; and the cells, situated at the edge of the section, were entirely converted into a jelly, soluble in water. The dissolved substance, as well as the loosened membranes of cells, were beautifully coloured blue by iodine. The author next remarks upon the effect of iodine upon the cell-membrane in general, and draws the following inferences:—1*st*, The iodine imparts very different colours to the vegetable cell-membrane, according to the quantity in which it is taken up by it. A slight quantity of iodine produces a yellow or brown, a larger quantity a violet, and a still larger quantity a blue colour. Iodine imparts the yellow or brown colour to the dried membrane of the cell, provided it is dissolved in alcohol, or otherwise comes in contact with the latter; the violet or blue colour, on the other hand, only takes place when the cell-membrane is soaked in water. The blue colour converts itself into the violet or red brown upon being dried, but resumes the former colour on being again moistened; analogous changes of colour, as is well known, also take place with the iodine of starch, according to the circumstances of the latter being dry or wet. *2dly*, The colour which the cell-membrane assumes through means of iodine, does not only depend on the quantity of iodine applied, but also on the quality of the membrane itself. The more soft and tender membranes, which swell readily in water, assume immediately a violet or blue colour, even when only a small quantity of iodine has been applied to them; or the yellow colour, which they at first assumed, passes into a violet or blue colour, even before the fluid has completely dried up; or, at all events, immediately after, and resumes it again on being soaked. The more hard, brittle membranes, which less readily swell in water, on the other hand, on the application of iodine, assume a yellow or brown colour; and, after being dried and soaked again, assume a blue colour, when a large quantity of iodine has acted upon them. *Third*, This development of a blue colour entirely depends on the nature of the membrane of the cell, and is only produced by the addition of a sufficiently large quantity of iodine.

Schleiden has published an Appendix to this Treatise, in the same annual series of the Flora, p. 737. He is of opinion, that Mohl might have drawn two conclusions from his researches:—1st, That iodine has no influence as a reagent upon starch, which indeed is the result of the discovery of the amyloid. Schleiden, together with Vogel, has found a substance in the cotyledonary cells of *Schotia latifolia, speciosa, Hymenæa courbar*, &c., which assumes a blue colour on the application of iodine, but in a different manner from starch; and he has published this in Poggendorff's Annals for 1839. 2dly, That the blue colouring of vegetable substances, by iodine, is no real chemical combination. Mohl has said, that the blue colouring of the membrane does not indicate a material difference from the ordinary membrane of the cell, on account of its not being probable, that cells formed of a different substance, should occur together in the same plant; but with regard to this, the reporter replies, that the only point of importance, is the question of what is understood by the essential difference of two vegetable substances. Mohl seems inclined to leave this point to the chemists, but is however of opinion, that in that case we should have to wait some time. This is followed up by a remark, which deserves to be inserted here, as it marks the peculiar manner of Schleiden. "On reading the good-for-nothing opinions of Berzelius and Liebig, respecting Schwann's discoveries with regard to the (*Gährungspilz*) fungus of fermentation, one would suppose that these gentlemen had never heard of such a thing as a microscope. On hearing Berzelius speak of Schwann's frivolousness, we do not know what to say to such absurdity. I should sincerely congratulate the science of chemistry, if Berzelius had always instituted his researches with a circumspection so thoroughly founded upon elaborate knowledge, and a profundity, combined with so much modest doubt in his own powers, as to secure him from the influence of preconceived opinions, as Schwann has done.* Did not the first hundred pages of the sixth volume of his chemistry occur to Berzelius when writing these words, and produce a blush of shame in him for such a judgment?"

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* Schwann has written a book, called "Microscopical Researches on the Identity of Structure and Growth of Animals and Plants"

The author then proceeds to the chemical qualities of many vegetable substances, and draws the following conclusions therefrom, which I will enumerate verbatim, in order that they may be understood: — 1st, "The vegetable substances, which are usually enumerated as indifferent ones (*amphotere*), and which belong to the series of starch, form only a very scanty selection of the infinite variety of materials, belonging to the same degree of development, which occur in plants. 2dly, The plant forms a chemical elementary matter in its vegetation (no allusion is meant hereby to the old nonsense of primitive mucus), which remains the same, in all stages of the process of vegetation, with regard to its elementary composition; but is, however, capable of infinite modifications, owing to internal changes, which are imperceptible, and altogether unknown to us, partially, also, to the increase and diminution of the water combined with it; the number of which depends on the number of atoms of water which associate themselves with it, and also on different combinations of elements, but which, for the present, appear to us as a constant series of different states, the nearest members of which do not appear to us to differ materially. The lowest of these members is sugar, the highest the perfectly developed substance of the membranes, — a series, the members of which become more insoluble in water as they rise from below upwards, so that, under certain circumstances, the gelatine from the cellular substance crystallizes from without in an organic form." (See Schwann's Microscopical Researches, &c., p. 220.)

It appears to me very advisable, however, to have recourse again to the chemists.

There is a report of a treatise of M. Payen "Sur la Com-

(Berlin, 1839); in which he adopts Schleiden's opinion with regard to the cytoblast, without any further scrutiny, and now endeavours to trace a similarity in the animal kingdom. Respecting it, see my Propyläen of Natural History; Berlin, 1839.

position Chimique du Tissu Propre des Végétaux," in the Annales des Sciences Naturelles, vol. xiii. p. 305.

The reporters are, Dumas, Pelouze, and Ad. Brongniart. Payen caused caustic potass in a heated state, then iodine, and occasionally sulphuric acid, to act upon different vegetable substances, and observed, that the original membrane, which constitutes the integuments of the cells, remained without any change. He found, on the other hand, that the deposits on this membrane converted themselves into a substance under the action of potass, which, on application of iodine, assumed a violet colour (blue-violet); and that, finally, a part of these new products, which he terms secondary ones, were converted by the same influences into another substance, which assumes an orange colour on the application of iodine. It appears, further, from his numerous analyses, that the vegetable tissues, both of the *Phanerogamia* and the *Cryptogamia*, by the continued solution of all foreign substances, which have either been deposited in their cavities, or on the membranes themselves, may be traced to a substance (cellulose), which constitutes the original walls of the cells of the cellular tissue, of the woody tissue, and of the vessels, which has the same composition as starch, and is only distinguished by its aggregated state, through means of which it exhibits a stronger degree of resistance to chemical influences. The similarity of the cellulose and of starch, with regard to elementary composition, the transformation of both substances into dextrine and sugar, would, indeed, in themselves, lead us to suppose, that intermediate states exist. In fact, the author observed, that the membrane of the *Cetraria islandica*, when properly cleansed, assumes a blue colour on the application of iodine, and is dissolved like starch in soda. The thick walls of the cells in the albumen of *Phytelephas* and *Dracæna* likewise, when properly cleansed, assume a blue colour on the application of iodine, but resist solution longer than the cellular substance of the *Lichenes*. The reporters add:—Cells of woody tissue, when freed from all foreign substances, so as no longer to assume a black colour on the application of muriatic acid, and of weak sulphuric acid; nor an orange colour, on the application of iodine, still retained some thickness, but had become soft and spongy; and this was also the case with the dots and stripes (*linéaments*) which do not disappear. They are of opinion, therefore, that the deposited substances are not only deposited externally, but have also penetrated into the internal structure of the tissue.

An elaborate treatise, on this subject, by M. Payen, is published in the same Journal, vol. xiv. p. 73, being the results of elementary analyses of the cellular tissue of various plants. These were:—The ovule of the kernels of almonds, pears, and apples, and *Helianthus annuus*, the membranous part of the cambium of cucumbers, the cellular tissue of cucumbers, the pith of *Sambucus nigra*, of *Æschynomene paludosa*, cotton cleansed once, and cotton cleansed twice, the spongioles of roots. The analyses fluctuate between 43 and 45 parts of carbon in 100; 6.04 and 6.32 hydrogen; and 48.55 and 50.59 oxygen. The formula of $C^{24} H^{18} O^{9} + H^{2} O$ corresponds with these analyses. Other researches are added to this. Leaves were, with difficulty, freed from a waxy substance, but at last gave a cellular substance of the same composition as the former. Spiral vessels of *Musa sapientum* evidently contained a covering, " matiére incrustante;" for, only on being cleansed by the application of ammonia, water, weak muriatic acid, &c., did they give 0.484 carbon; on being treated by potass with heat, only 0.44 carbon; the latter had otherwise the same proportion as the normal cellular tissue. The pure membrane taken from the grains of wheat had the usual constituents. The cells in the circumference of the albumen exhibited a grey colour, which originates from a gelatinous substance that covers the membrane. The application of tannin colours and contracts this substance, ammonia and acetic acid dissolve it, and leave the pure membrane; solution of iodine colours the gelatinous substance yellow, the starch dark violet, and leaves the membrane uncoloured. There remains in the grain only pure membrane after germination. Vegetable remains, from cow dung, were easily cleansed, and the membrane then had the usual composition. The hair of the seed of the Virginian Poplar Tree behaved in the same manner as cotton. It was difficult to separate firwood from all foreign substances; the membrane, however, after this had been accomplished, exhibited the usual composition. The membrane of *Cetraria islandica*, cleansed by water, alcohol, ammonia, acetic acid, and ether, still assumed a blue colour on the application of iodine; and the jelly of this lichen contained hydrate of starch and inulin. This last substance is resolved into a sugar by acetic acid, which is dissolved in water, and also in alcohol. On dissolving inulin in boiling water, it is separated, when left to cool, into small, white, and transparent globules, like starch globules; they do not, however, assume a blue colour on the application of iodine. The albumen of dates may be entirely dissolved by potass, in the same way as the membrane of *Cetraria islandica.* It was more difficult to remove deposited substances from the *Confervæ* and *Chara hispida;* precaution was necessary with the *Fungi;* but a membrane of the usual composition remained in all these cases. The author describes different forms of starch granules in the *Chara;* but they were not different in a chemical point of view. The tender membrane in the orange coloured organs of the *Chara* exhibited the usual composition of vegetable membrane; the substances contained in it, however, were very nitrogenous. The author expresses the opinion, that all nitrogenous materials in plants, are only deposited, whilst they penetrate into the membranes themselves of animals. He obtained the prepared gut of a sheep, from a manufacturer of stringed instruments, treated it with water, acetic acid, and potass, of which the two latter had a peculiar dissolving effect, analyzed the remainder, and found a nitrogenous quaternary compound. This residue had also, in other respects, the general qualities of animal membrane; it dissolved in acetic acid and diluted muriatic acid, which is not the case with vegetable membrane. The author compares the distinguishing marks of pure vegetable and animal membrane; and, besides the one enumerated, I may add, that the latter is dissolved by the diluted solutions of potass and soda, and ammonia, but not the former. Further, that tannic acid, alum, and corrosive sublimate, do not act at all, or at all events only in a trifling degree, upon the former, tannic acid contracting it a little; the latter, however, is not only contracted by it, but combines with it.

This excellent work presents decided answers on many disputed points.

I may here be permitted to add something respecting the starch in plants. I have illustrated the changes of the granules of starch in the 16th Table of the *Icones Anatomicæ Botanicæ.* The granules of potatoes were burst by warm water, and yielded a thick fluid mass, which assumed a blue colour on the application of iodine, the same as the enclosing integument. It follows from this, that each granule of starch contains a thick fluid kernel, as Raspail asserted, although the integuments consist of many layers, as may indeed be distinctly seen in many granules of starch, just as Fritzsche first observed. As this thick fluid kernel assumes a blue colour on the application of iodine, like the integument, there is no reason to doubt that it consists of any thing else than a mass of amylum. It is an ordinary occurrence, that this mass is changed into gum or dextrine, by being strongly heated, or by a lengthened rubbing with water, as Raspail applied it, and a similar transformation takes place on the more usual application of nitric acid. The experiment should be performed as soon as the bursting has taken place, in order to avoid any change occurring in the starch. The integument of the granules is frequently found torn after germination; see fig. 9 and 10 of the same table, compared with fig. 8. Unformed thick fluid starch I first found in the bulbous-formed roots of *Salep,* subsequently also in the bulbous-formed roots of the common *Orchis latifolia,* before and after blossoming, as is seen in fig. 13 of the same table. Later, I also found amylum in the roots of *Orchis pyramidalis,* and in the roots of *Orchis latifolia,* long after blossoming. As usual in granules, Roots of *Salep* are also met with, that contain granules of starch. It seems, therefore, that the unformed matter is capable of transforming itself into granules. A thick fluid mass, which cannot be coloured by iodine, mixed with large granules of starch, is also found in the seed of *Phaseolus* *vulgaris*, fig. 12. Large and small granules of starch are generally mixed with each other. The most external cells of the grain of wheat, in which, according to Payen, the most gelatine is contained, contain small granules of starch, as if they were developed from gelatine. Mohl, I think, was the first who observed that starch developes itself in chlorophyll; it may be observed, with peculiar distinctness, in the older leaves of the *Vallisneria spiralis*, where a granule of starch is produced in the granules of chlorophyll, as may be perceived by the application of iodine. It is remarkable, that the movement of the chlorophyll granules immediately ceases, as soon as a granule of starch has formed itself in them.

Vegetable substances are by no means so uniform as the mineral substances. Saltpetre is saltpetre, and common salt common salt, let it be prepared in what way it will, if it has only been properly cleansed. This is not the case with many vegetable substances—for instance, with alcohol, the vegetable acids, &c. In others, this chemical universality, if I may so term it, is not so great as is seen in sugar. The vegetable substances, indeed the organic substances in general, only form genera and species in most cases. Thus the etheric oils are different in every kind of plants, and this is also the case with the isomeric compounds; also with the resins and gums; and although they have but five distinguishing characters, yet they differ in their qualities in almost every plant. This is also the case with starch, for although it has the same characters from wheat, potatoes, and from arrow root, yet the jelly obtained from them exhibits differences. Potato starch, for instance, has a peculiar smell. In this instance, therefore, as indeed is done generally in natural history, we reduce the species into genera, which we distinguish by certain marks; and thus every thing is called starch, which presents itself unformed or in granules, that assumes a blue colour on the application of iodine, and that is dissolved in warm water; and not in spirit of wine, ether, and oils. The *Althæa* mucus also, at least partially, belongs to the genus starch; it forms granules, which become blue on the application of iodine, which dissolve themselves in cold water, and which form a mucus that is likewise turned blue by the tincture of iodine. See *Icon. Anat. Bot.*, table 16, fig. 14, *a. b.*

It is a matter of surprise to me, that Payen has paid no regard to the cellular substance of potatoes, which seems to approximate to the membrane of the *Lichenes.* As to *Cetraria islandica,* it behaves itself as I have represented in the third volume of the selected *Anatom. Bot.* Figures, table 5, figs. 1 and 3 (1841). The most external layer, which generally consists of an intercellular substance, does not become coloured by iodine; the second layer, consisting of very tender close tubes, exhibits a strong colouring by iodine; and again, the most internal, very loose layer, which consists of larger tubes, is not changed by iodine. It is different with *Lobaria pulmonaria,* and *Roccella tinctoria;* the external layer does not become coloured, but the internal, very loose layer, consisting of rather thick tubes, does; the second layer, which is coloured blue in *Cetraria islandica,* is also entirely wanting here. See table 5, fig. 13, and table 6, fig. 5.

The production of new cells, in relation to those already existing, may be conceived to take place in three different ways. The new cells are produced at the ends, edges, or within the circumference of the older cells; or they are produced between the older cells; or they are produced within the old cells, by a mother cell being torn, or otherwise destroyed, which causes the new cell to come forward. The last mode of production is assumed by Schleiden, who describes the new cells as produced from a dark nucleus "cytoblast" (which R. Brown has particularly observed in the young cells of the *Orchideæ*) within a mother cell. I have made some researches on this subject, and the result of them I have given in the second volume of the *Icones Selectæ Anat. Bot.* (1840), tab. 6, figs. 1–8. The young leaves are most easily investigated in juicy plants; the bud is only a round projection of the trunk, on which the leaves are situated like small granules. Fig. 1 represents such a leaf of *Sempervivum arboreum,* magnified 315 times in diameter; and fig. 2 exhibits the point of such a leaf, magnified 600 times. A dark material is perceived in the cells of fig. 1, which is less distinct in the cells of fig. 2, which, however, in the final papilla, seems to be bound into a sac. This papilla disappears when the leaf begins to grow. The projection of the trunk itself, with the young leaves or the bud, is found in fig. 4, magnified 100 times; and in fig. 3, magnified 180 times. There is scarcely any foreign matter perceptible in the leaves, but a granule is certainly found in the projection of the trunk, which afterwards disappears; no trace of cells is, however, found any where one within another. If we were to call the entire young leaf a mother cell, in as much as it may be surrounded by a cuticle, this would be a mere quibble, since this little skin is torn and disappears, and thus allows the cells to come forward; indeed, the individual cell distinguishes itself from the skin of the leaf, by the former enclosing no other cells than that of the latter. Fig. 5 exhibits a young bud of *Quercus robur.* It exhibits just the same structure as the juicy plants, a projection of the branch furnished with leaves, the only difference being this, that it is curved in this and straight in that. Cells, 780 times enlarged from the projection, are seen in fig. 6. The green substance, chlorophyll, is exhibited distinctly, of a pale green colour; but one cell within another is nowhere to be seen. All this is confirmed by the representation of a bud of *Syringa vulgaris*, which would only have developed itself in the following year. As young cells are never perceived, therefore, in the interior of the old cells, we have reason to assert, that an enlargement of the cellular tissue, by means of mother cells, does not take place in these plants.

A preliminary answer to H. Mohl's treatise, respecting the structure of the annular ducts, by Dr. M. J. Schleiden, is found in *Flora*, vol. xxiii. p. 1. It is necessary, however, to go back as far as the year 1839; partly in order to understand the subject in general, and partly because Meyen's representations are very defective. The same author has published observations in the same journal, respecting *spiral formations* in the cells of plants. The cells of plants, he states, inclusive of the so termed vessels — but setting aside the latex ducts — exhibit two periods in their life. In the first period, which is the period of their production and isolated independent development, the membrane forming them, grows in its whole substance through intussusception. As soon, however, as the cells have joined the cellular tissue as the constituent matter of a certain plant or its parts, that kind of growth ceases, or, at all events, retrocedes very much. But a new and important circumstance is now added to the other phenomena, namely, that a new layer is deposited upon the whole internal surface of the wall of the cell, in the form of one or more bands, closely twisted together, so that the spires exhibit the most exact contiguity without any continuity among themselves. Originally, such is the opinion of the author, two bands existed together, arising from an ascending and descending current of the formative matter. The author first of all contemplates the case, when the cell has not attained its perfect development, at the period when the thickening of its walls commences through means of spiral deposits. We find here the following cases:—*a*. Simple fibre (double in the sense stated above). The cell extends itself considerably from the moment of its production, individual spires grow together early, and others become disunited and form annular ducts. The author subsequently expresses himself more distinctly, by stating, that this laceration or separation takes place by means of resorption. *b*. Simple or manifold fibre, with an extension of the cell, and slight or no connection with the wall of the cell. Spiral vessels, capable of being unrolled, with wide spires. *c*. Simple or manifold fibre, with a more considerable extension of the wall of the cell; which are generally closely grown together. Narrow spired (not ?) spiral vessels, that are capable of being twisted, false tracheæ, and partially banded and scalariform vessels of the older writers. *d*. Manifold fibre, with moderate extension of the cell; particular portions of the spire grown together; generally, also, they adhere to the wall of the cell. The entire series of forms, from the so termed branched spiral, to the reticulated vessels. A portion of the banded and scalariform vessels of the older writers also belong to this division. The author then proceeds to the second case, stating:—If the cell, however, has already attained its perfect development at the period when the spiral deposits commence, a new and most wonderful circumstance takes place, namely, the formation of air vesicles on the outside of the cell, between two adjacent ones, which precedes the production of the deposits, and the spires in the inside at the locality, which corresponds to the place of those air vesicles, separate themselves from each other in the shape of fissures. All porous cells and vessels belong to this division; likewise, however, a portion of the former banded and scalariform vessels, which are only distinguished by the length of the slit of the pore, from the so termed porous vessels. The author further alludes to the differences of the cells as to form, which pass from the small globular to the very lengthy form. The vessels, according to his opinion, are produced by the intervening walls of the cells being absorbed; he also says, that the perforation of the primary membrane, in the leaf cells of sphagnum, is produced by resorption. The author likewise adds, that it is not always only a single deposit that remains, but several repeated, and in such a manner, that they either lie one upon another, by which the broad plates in the sphagnum cells are produced, or when this does not take place, as in the pores of *Taxus baccata*. Previous to this, appeared a treatise by *H. Mohl*, in the same Journal, vol. xxii. p. 81, respecting the structure of the *vegetable cell membrane*, which is particularly directed against Meyen's opinions; and, among others, against the opinion, that the membrane of cells is formed of spiral fibres. In this treatise, he also maintains the opinion, that the fibres and punctations of the cells originate from a deposit of a secondary, upon the external membrane, in many cases even from a tertiary membrane. He believes, the process of formation of the simple, particularly of the secondary cell membrane, is governed by the rule, that the organic substance is not deposited perfectly uniform, but is deposited in some places in larger, in others in smaller quantities; and it is when this unequal deposit occurs at some places in larger quantities, and is entirely wanting between the deposits, that these large deposits either (particularly in lengthened cells) take place in the direction of a spiral, or (especially in shorter cells) in the direction of the fibres of a net. There is another treatise in the same volume, p. 673, by *H. Mohl*, respecting the annular ducts, directed against Schleiden, who asserts (as already mentioned), that annular ducts, which are capable of being unrolled, were formed from the basis of spiral vessels, the fibres of which have grown together from two spires which have become closed, and which subsequently become isolated by the resorption of the spiral formed portions of the fibres that are situated between. *H. Mohl* observes,—" I have explained the reasons in the treatise respecting the vegetable cell membrane, which are in favour of a fibrous structure, belonging to those secondary cell membranes, that are distinguished by stripes; and by a greater degree of capability of tearing or separating themselves in a spiral direction; and by depressions and furrows, which extend themselves through the entire thickness of the membrane of the cell; and, in a still higher degree, by fissures." He considers the structure of the fibre, which forms the annular ducts, to be quite analogous to the structure of the spiral fibre, and shows, that (especially where the rings are situated near to each other), in the lines of division, shallow or deeper furrows exhibit themselves, which are quite parallel to the edges; and that (where they are more removed from each other) a regular spiral fibre runs between them in other cases, which either connects itself with the rings or not. This representation alone must cause a doubt with regard to Schleiden's theory. A principal reason, however, is the examination of *Tradescantia tuberosa*, to which Schleiden refers, especially of the roots, where (in the first states in which the fibres exhibit themselves) they have already the same differences of form, viz.:—Annular and spiral fibres, as in the subsequent states. This is followed by the preliminary answer of Schleiden, to which we have alluded in the commencement. He states, that he does not believe that he has been mistaken in his observations, but that he has seen real stages of transition, as the stationary rings are distinguished essentially by sharpness of delineation, firmness, and clearness of substance, from the yellowish jelly-like transitionary matter of the spiral, which is already partially destroyed at the edges, and in the act of decomposition. Some of the annular fibres, with spiral fibres of Mohl, he considers to belong to the reticulated tissues. He states,—“ Generally speaking, I am inclined to pronounce the inference from the developed forms, upon the history of the production, as very dubious, for it cannot have escaped the observation of Mohl, that secondary fibres, in very many cases, develop themselves as links of connection, subsequently to the formation of the fundamental spirals; and which fibres, although consisting of quite a different substance (because they are soluble by being boiled in caustic potass), are apparently not different from the spirals, and thus renders the recognition of the fundamental spiral exceedingly difficult.” He is inclined to attribute such a secondary mode of connection to one represented in Mohl’s figures. Schleiden says, at the conclusion,—“ The reason that particularly induces me to persevere in my views, is the philosophical necessity, inseparable from the genuine investigation of nature, of limiting the number of modes of explanation, so long as a new reason is not absolutely required, in consequence of the impossibility of explaining a phenomenon by an old mode of interpretation.”

Herr Schleiden’s theory, respecting the spiral formations in plants, is a hypothesis. The explanation of the different forms of these formations, out of the relation of their production to the increment of the cells, is very ingenious and convenient, if it could only be proved to be true. But there appears to us to be a fictitiousness about the wonderful air vessels, which are to constitute fissures and pores, and no other investigator has observed any trace of them. A number of questions might be put in objection to this view, as, for instance, How can air bladders produce regular formations, and how is it that they do not act equally upon both sides? Whence come these air bubbles? It is not probable, that vessels can be produced from the absorbed walls of cells, as it is in their young state that they do not present walls at all. The author is fond of attributing effects to resorption. He probably intends to say “ decomposition,” fusion, or something of that kind, for we know of no re or absorbing vessels in the vegetable kingdom. Schleiden is right, when he says, that it is a genuine philosophical principle, to limit the number of explanations, provided the reasons existing are sufficient. Thus Newton applied this doctrine, by stating, that the movement of the heavenly bodies did not require any other explanation than the one given by him. But it would, indeed, be unphilosophical to carry this doctrine so far as the author. For how can any one admit the impossibility, in experimental sciences, of explaining an experiment, according to an old theory, when one is bold enough to create hypotheses; such, for instance, as has been done here about a deposit in spirals. Such a doctrine would be very acceptable to M. Dutrochet and the mechanists.

Herr Schleiden mentions my former opinions respecting the spiral formations in plants, at the commencement of his treatise, in the twenty-second volume of the Flora, with a view to pronounce them incorrect. He is perfectly right there, for I myself have found them to be incorrect. He further says:—" Link is still far from understanding all the facts connected with Botany, and unable to arrange them from a correct point of view, as is seen in his newest edition of the Philosophia Botanica." He may likewise not be wrong there, for I am far from being so conceited, as to imagine that I have perfectly understood nature.

We have not enumerated, above, a slight controversy which took place between Mohl and Schleiden, respecting the right and left directions of the spiral fibres, because Schleiden renounces his opinions at the commencement of his preliminary answer, and even accuses himself of thoughtlessness.

Mohl says (Flora, vol. xxii. p. 676), " No doubt can be entertained by any one, who has investigated the development of the spiral fibres and the spiral cells, and who has recognized the decided analogy between these two formations and the dotted cells, that the fibre of the spiral vessels is no peculiar formation, existing by itself, but that it must be considered as the secondary membrane of the vascular sac, which has a spiral direction, and is divided into one, or into several parallel bands." I beg to ask, Was the membrane connected in its first formation, and did the separation into fibres only take place subsequently? I shall demand proofs if this question is answered in the affirmative; and if in the negative—if the fibre is assumed to be separated from the membrane immediately at its first formation—I shall then ask further, What difference is there in saying, the fibre is a peculiar independent tissue; or, a membrane is peculiar, and primitively separated into fibres? The word "depositing" does not explain any thing; on the contrary, it has the improbable unproved meaning, that the formation of the fibre and of the membrane was a mere act of precipitation.

Even when the fibre is pressed rather flat, it has no similarity with the parts of a membrane; for, on magnifying 1500 times tissue from very young roots, the tender fibres of the spiral vessels may distinctly be seen rounded on the edges. The enclosing external membrane at that period is so tender, that it cannot be perceived. I should like to reverse the matter and to say, Whoever investigates the development of spiral vessels and of spiral cells, must acknowledge the fibre to be a peculiar independent formation. With regard to the pores, I am of Mohl's opinion, that the opening is covered with a tender membrane, and as I could not comprehend how it was, that a secondary deposit could be absent from certain localities, I thought these places were little bubbles, such as are seen in a glass. This, however, was a mere conjecture. My delineator always denied the existence of this membrane. At last I was in hopes of convincing him: we saw it coloured, as it is represented in Icon. Select. part i. tab. v. fig. 6, 7. But, afterwards, I never saw any thing of the kind, and the microscope which I made use of had the quality of colouring objects under certain circumstances. Herr Schmidt still maintains, that the pores penetrate the walls; and if we are of a different opinion, my opinion, as a preconceived one, must be doubted.

I likewise not unfrequently observed, especially at the edge of the pores, that several membranes of the same kind were situated one above another. This may often be seen very distinctly in the tubes of the liber. See Icon. an. Bot. F. 1, table 6, fig. 15. Payen's experiments prove, that the deposits are different from the membrane formation. The spiral formation belongs to the membrane, because it is not dissolved by being boiled in caustic potass or soda.

Mohl has taken great pains to refute Meyen's assertion, that the vegetable membrane is formed of spiral fibres. This assertion is only of value as far as it goes, because, by far the greatest number of membranes, in the vegetable kingdom, do not exhibit such a composition. I told him, immediately, that I could not find what he had, even in the ærial roots of his *Stelis.* It is very remarkable, that many portions of plants have a tendency to split into a spiral line; but this only takes place with the thicker parts; for instance, with the old porous vessels, and even with the bark, as in the birch tree. We need not, therefore, go back with *Mohl* to a molecular position, but leave that to the natural philosophers. And if the membrane were ever so thin, it would be a more simple assumption to suppose still thinner places, in which the membranes tear themselves to pieces. It is very true, that no definite and distinct difference exists between vessels and cells in the vegetable kingdom, yet we must retain the expression of the difference for the science, in order to prevent confusion. If we were to call the external part of the flower of grasses, bracts, or leaves, because they, in point of fact, happen to be bracts, and eventually leaves, it would give rise to infinite confusion; and how many terms would not be necessary, in order distinctly to express what bract or what leaf is alluded to? Raspail, indeed, has given such a description of grasses, and it was only owing to no notice being taken of it, that it did not occasion confusion.

The *vasa propria* of the calyx of *Chelidonium majus*, I have caused to be represented in the second volume of the Icon. Sel. An. Bot., t. vi. fig. 1 (1840). The arrows attached to the figures indicate the direction of the current. It follows thence, that the current does not always originate in the flowing out of the juice from the parts that have been torn off, as many believe, and as, indeed, often is the case, for the stream by no means runs towards the outside, but rather from the outside towards the inside. As the calyx of *Chelidonium* is very thin, we only need to tear off the small leaf, without making any incision, when it leaves only a small spot from which the juice can flow. This discovery, made by Herr Schultz, is therefore certainly a peculiar discovery, and is readily seen, without there being any necessity for making the observation in sunshine. For the movement which is seen in the sunshine, especially in leaves that have been torn off, is an optical delusion, and the stream may be directed at pleasure towards one or towards the other side, according as one turns the mirror. Professor Amici convinced me of this, at the Assembly of Naturalists at Pisa, in the autumn of 1839. The flickering motion, which is seen simultaneously with this, may likewise be owing to an optical delusion. These peculiar vessels, which in Latin one might probably term *vasa laticifera*, are by no means always simple in *Chelidonium majus*, as I formerly believed, but branched. Simple they certainly are in the vicinity of the leaf nerves, and in that of the bark of the root, and in the wood of the trunk. As such they have also been represented in the Icon. An. Bot. tab. 14, figs. 6, 7, 8. It appears to me, that the branching of these vessels may be mentioned as a principal character, by which they may be distinguished from all other vessels, even when they have no coloured juice. But these vessels must not be mistaken for the long cells, or the vessels in the accompanying tissue (the woody bundles), which never are branched, never carry a coloured juice, and in which a movement of juice has never been observed, which mistake, indeed, has been committed by many, and is still made. The circumstance of the latex vessels having been investigated only in the vicinity of the woody bundles of the trunk, and of the leaf nerves, in which very localities they are simple and similar to those of the liber, has given rise to this error. Their curved and branched forms may soon, however, be found, when they are examined in the flat parts, and removed from the nerves.

Stomata are represented in the second volume of the Icon. Sel. F. 2 (1840), tab. 4 and 5. First, *Stomata* of the usual form, consisting of two curved cells, having a slit-like opening between them, and which are surrounded by one or more annular cells: fig. 8, of *Epiphyllum phyllanthus;* figs. 9 and 10, of *Opuntia vulgaris;* fig. 11, of *Cereus flabelliformis.* The chlorophyll forms, in figs. 9 and 10, an oblong substance. The enclosure in *Rhipsalis salicornioides*, fig. 7, consists of several cells placed in a circle, and the internal curved cells are also seen grown together into a small ring. The stomata of the *Hakea pugioniformis* are also of the same form, but a veil, consisting of a deposited matter, which wholly or partially overspreads the stomata, is also frequently seen in them, although not always. Fig. 3, of the fourth table, exhibits a quite free and a half-veiled stomate; fig. 4 an almost entirely covered stomate. This veil, or rather obstruction to the stomate, is seen still more distinctly in the stomata on the leaves of the *Coniferæ.* Table 5, fig. 6, of *Cunninghamia sinensis;* fig. 7, of *Picea excelsa;* fig. 8, of *Picea alba.* Free and obstructed stomata, at one and the same time, are found on the leaves of *Araucaria excelsa*, fig. 2, and of *Araucaria imbricata*, fig. 4. On boiling the leaves with water, the stomate becomes free, as may be seen in the stomate of *Araucaria imbricata*, fig. 5. Boiling them with spirit of wine does not affect this so readily. I did not succeed at all in doing it. I have always entertained doubts, that the stomata were the air holes of plants, and consequently the organs of respiration. I do not find a distinct connection between the stomata and the chasms in the cellular tissue of the leaves. It always appeared strange to me, that organs of so distinct a structure should only lead to mere chasms in the cellular tissue; and the obstructing and covering matters which they produce, have finally induced me to consider them as organs of secretion.* But I must leave the matter in doubt, for I confess, that I should not know what to say, if I was to be asked, "What secretions are formed by stomata in which such obstructions are not observed?" Certainly much has been said about open and closed stomata. I myself have said much, and it is very possible that the obstructed stomata have been taken for closed ones.

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* Mention will be made of a contention between Dutrochet and Delile respecting this subject, in the Annual Report for 1841.

But let us hear what Schleiden says respecting these things. "In vain" (he says, in his inoffensive observations respecting the nature of the stomata, in Wiegmann's Archives of Natural History for 1838, vol. i. p. 57) "have I tried to ascertain a fact, by which it might be rendered probable, that these secretions originate more from the exhalations of the alleged glandular cells, than from those of the other parenchymatous cells, especially from those which border immediately on the cavity into which the stomata conduct; and it appears to me, that the alleged function, considering the present state of the science, is nothing but a mere *petitio principii.* For instance, let us take the *Coniferæ.* Here I find resin on the stomata; on removing this by etherical oil, the stomata exhibit a continually increasing chasm. I next find beneath it a cavity, which (including the two curved cells) is surrounded by nothing but cells which contain gum, mucus, some starch, chlorophyll, but no trace of resin or turpentine; on the other hand, I find large turpentine ducts much lower down in the parenchyma; and I now conclude, that the volatile turpentine oil makes its exit from those ducts in the form of vapour, arrives at the intercellular cavities by following the intercellular ducts, and evaporates into the atmosphere through means of the stomata; in doing which, according to its nature, it leaves a certain quantity of resin. This inference appears to me quite natural. But, on the other hand, if two of those perfectly equal cells, filled with green matter, are arbitrarily chosen, and supposed to constitute glands which secrete resin, because they happen to be situated near the exterior, I really cannot see how this can be justified by any kind of logic." I find the cells beneath the resinous covering of the *Cistaceæ,* and of many other plants, green; and I cannot conceive how the oil of turpentine, which is alleged to make its exit from the turpentine ducts in the shape of vapour, can leave resin in the stomata. However, I am glad that my opinion is similar to that of my friend Berzelius. He has certainly been still more abused about it than myself, because he is a greater man than I am.

In the "Journal of Natural History and Physiology, by Van der Hœven and De Vriese, Leiden, 1840," we find, p. 185, a paper, entitled, "Micrometrical Determinations and Microscopical Researches, by P. Harting." Many micrometrical determinations of vegetable objects are contained in this treatise, of which I will only enumerate some, because the whole table would otherwise have to be copied here. They are stated in ten thousandth parts of a millimeter. The smallest spiral vessels from the chalaza of an oak, impregnated within a few days, measured 33 ten-thousandths of a millimeter; the thickest, from a twig of one year old of *Sambucus nigra*, 425; the thinnest from the same, 140; the spiral fibre from the former, the thickest, 39; from the latter, the thinnest, 27. The average diameter of the dots, on the dotted spiral vessels from the same twig, 48. Rings from an annular duct in the same twig, average diameter, 38. Stomate of a tolerably large leaf of *Lilium candidum*, average length, 712; average width, 520; average length of the slit, 420; average width, 123. Stomate of a matured leaf of *Leontodon taraxacum*, average length, 230; average breadth, 130. Stomate of a matured leaf of *Lemna minor*, average length, 192; average breadth, 160; average length of the slit, 142; average breadth, 90. Pollen granules of *Malva rotundifolia*, 1341: of *Lilium candidum*, average length, 925; average breadth, 392: of *Lathyrus odoratus*, average length, 517; average breadth, 283: of *Salix alba*, average length, 272; average breadth, 126: of *Lamium purpureum*, average length, 412; average breadth, 248: *Lamium album*, average length, 308; average breadth, 202: of *Aconitum Napellus*, average length, 83; average breadth, 47. Chlorophill grains from a leaf of *Sambucus nigra*, average diameter, 50: of *Chelidonium majus*, 55: of *Sedum telephium*, 67: of *Geranium robertianum*, 52: of *Malva rotundifolia*, 51: of *Iris pseudacorus*, 42: of *Lilium candidum*, 30: of *Georgina variabilis*, 34: thickness of the layers of a grain of potato starch, 8–30. Although some uncertainty always takes place in micrometrical measurements, these statements are, nevertheless, very valuable as proportional numbers; and it is therefore very desirable, that the same observer should continue his observations with the same instrument. The number of animal objects which were measured is much greater than that of the vegetable ones. I only beg to remark, that the blood-globule (*bloedshyfjes*, blood-shields as the author calls them, which is a new Dutch word) of almost all animals are larger than the grains of chlorophyll. The muscular fibres of animals, on the other hand, are generally thinner than the spiral fibres.

The invention of M. Boucherie, of imparting useful qualities to wood, by causing different fluids to be imbibed by it, deserves mention at the conclusion of this department. (See Comptes Rendus, 1840, vol. i. p. 686). The thought was suggested to him by the well known experiments, causing coloured fluids to be absorbed by, and to rise in the vessels of plants. Those experiments, which have hitherto been merely instituted for scientific purposes, he wishes to apply to purposes of general utility; or, as he expresses himself, he is desirous of creating an industrial power from the vital power. The operation is performed on a tree which is still standing upright, by making a transverse incision, so as to bring the sap vessels in connection with the solution which the tree is to imbibe; sufficient wood must, therefore, be left standing at two opposite points, so as to enable the tree to retain its vertical position. The absorbing power decreases on separating the tree from its roots (*de sa souche*), and from the moment of its being hewn down; use may, however, be still made of it for two days, or even for a longer period. This power, however, is different at different seasons; it is strongest in the autumn. The quantity of fluid which is absorbed also varies very much; but, as a general rule, it may be said, that the neutral combinations are imbibed in greater quantities than the acid and alkaline. In order to render the wood durable, he causes the brown coal-tar (*pyrolignite de fer*) to be imbibed; and to impart to it a greater flexibility and elasticity, he makes use of solutions of soluble chlorides, and the same are also useful in preventing the wood from being warped, and serve the purpose of rendering the wood less combustible. The dying of the wood is done by mineral or vegetable substances. If the former be used, the liquid already coloured must not be used, but two liquids must be applied successively, which produce colour by their mutual decomposition; thus, if one wants to dye blue, first a salt of iron, and then cyanide of potassium (cyaneisenkalium) must be used. Coloured vegetable liquids are incapable of being imbibed. Certain woods, indeed, do not imbibe any thing at all. These practical applications confirm, very strongly, the now almost generally adopted theory of the rising of the sap in plants. Further on, mention will be made of the formation of vessels and cells, especially on speaking of the treatise of D. Don on the *Cycadaceæ*, and of Schleiden on the *Cactaceæ*.

STEM, LEAVES, AND BUDS.

OUR knowledge of the stem has been enriched by an elaborate work, which well deserves the attention of investigators:—*On the Structure and the Growth of Dicotyledonous Stems*, by D. F. Unger; a prize treatise, to which the reward was adjudged by the Imperial Academy of Sciences at St. Petersburg. St. Petersburg, 1840, 4to, 204 pages, 16 tables. We will follow the author as far as our space permits, for to him the science of the physiology of plants owes much already. He first enumerates the usual division of the stem into pith, wood, and bark. The wood he again divides into the medullary sheath, the real wood, in which the ripe or heart wood is but little distinguished from the alburnum, and the cambium-layer, which he describes as a layer of tender cellular tissue. The bark he likewise divides into the upper layer or epidermis, the cork-layer, and the cellular integument. The latter, he says, contains chlorophyll nodules, and is the substance which forms the medullary rays. This is followed by a history of the theories on the growth of the *Dicotyledons*. I will not refer to the statements of others on this subject; but he has entirely mistaken what I have said. After having referred to a former opinion of mine, which is incompatible with my later opinions, he states the following, page 27:—" It is the opinion of both Link and Meyen, that the stem grows through the buds, which means, that the new layers of wood are the produce of the buds. The former says (El. Phil. Bot., Ed. ii. 261), it may be seen with the naked eye, that a layer of wood issues from the bud into the branch beneath, and attaches itself to the wood, and on using the magnifying glass, young spiral vessels, &c., &c., may even be perceived to penetrate into the branch." If the author had taken the trouble to read the sentence, he would have seen, that I certainly said, "That vessels with a cellular tissue issue from the bud downwards into the branch," but by no means, that the entire new layer of wood was formed by it, but that the latter also grows to it from the sides, so that the vessels, as it were, inoculate one another. The manner in which this is done, I have not only elaborately described, but also representd in the seventh table of the Icon. Anat. Bot. part i. table 7, fig. 6–12. He recurs to my former opinion in page 111, and carefully states who has confuted it. He then adds, p. 112,—"Link has latterly changed his views on this point, and he pronounces the spiral vessels, in the vicinity of the pith, to be unchangeable, as Mirbel and others have shown. He gives 'the alder' as an instance, which exhibits, after forty years, the same vessels that it had at first." This is all that he says of my representation, and he has thus shockingly mutilated it. He also says, p. 121,—"Link places the cambium layers with the liber, and calls them 'internal liber.'" The sentence referred to treats of the sap, which I certainly distinguish from the cambium. But this shall not influence my analysis of what follows.

The third division treats of the structure and the growth of the *Aloineæ*. He commences with these, because they have the greatest similarity in their structure with the *Dicotyledons*, as the stem consists of bark, wood, and pith. The author draws the following inferences from his researches upon the *Dracæna ferrea*:—1st, A homogenous tissue, which belongs to the cellular system, and which is distinguished by the circumstance of its extended cells carrying a more or less cloudy coloured juice, is the original basis of the vascular or woody bundles. 2d, The development of the vascular or woody bundles, considering it in its whole course, does not take place in an uniform manner, but portions of it are capable of being developed in a higher degree, whilst others remain in their original simplicity. 3d, The same central point from whence a perfect development of the vascular bundles takes place in both directions, is the point also where the latter leave the stem, to the formation of which they contribute the essential part. 4th, Between the internal or the stem-part, and the external or the leaf-part, of the vascular bundles in the plant, there is an opposition, which, remarkable enough, never produces an identical matter, but only that which is analagous, and in proportion to the distance from the central point. 5th, With regard to the nature of the elementary parts, or the origin of the vascular bundles, it appears that the proper vessels (vasa propria) form the first and most essential part of them (the author explains, that the proper vessels consist of thin walled cells, consequently they are very different things from those which are called so by other Botanists), not only in as much as they are the elementary parts which first of all appear, but also because they form the most permanent part of the tissues, and never entirely disappear among all the metamorphoses of the vascular bundles, and consequently cannot be replaced by other tissues. I must leave it to others to search for proofs of the truth of these conclusions.

IV. *Comparison of the Development of the Vascular Bundles in different Monocotyledons.*—In this part, the course of the vascular bundles in the palms, according to Mohl, and in the *Aloineæ* (in which there is no ramification, as Mohl found in the palms), as Meneghini describes it, is adopted. The course and ramification of the vascular bundles in the *Ananas*, and also their course and entangling in the grasses, are considered.

V. *On the Structure and the Development of the Piperaceæ.*—We give the authors own words on this point. In all *Piperaceæ* there is a central system of vascular bundles, which may be distinguished from a peripheral system; these two systems consist of parallel vascular bundles, which run through the stem, and nowhere anastomose with each other.

The two systems unite themselves in the node into a fibrous net-work, from which spring buds and roots, in such a manner that their separated systems of vascular bundles enter into immediate connection with those of the stem. The formation of the wood only takes place through the peripheral vascular bundles, by the production of woody matter on their outside, and which consists partly of new vascular bundles, and partly of cells of prosenchyma. The system of vascular bundles of the appendices is only connected with the central system of vascular bundles towards the exterior, and appears as its immediate continuation. A part of the same system of vascular bundles continues its course upwards, from which it follows, that a continued growth of its bundles is peculiar to this system of vessels (vegetatio terminalis). The same also holds good with regard to the peripheral system of vascular bundles; but since this enlarges itself towards the exterior by the deposit of vascular bundles, of a second, third, and fourth rate order, it exhibits a complicated vegetation. The author calls this mode of growth "vegetatio peripherico-terminalis." He then speaks of the structure of the related genera, *Saururus*, *Houttuynia*, and the *Chlorantheæ*.

VI. *On the Structure and Development of the Nyctagineæ.*—The following are the results of the researches which the author instituted with regard to the formation of the stem of the *Mirabilis*. A double system of vascular bundles may be distinguished, an internal and an external one. The internal system is simple, and consists of a zone of vessels, and of the central vascular bundles enclosed by it, and which enter into the leaves; the external system, on the other hand, consists of many circles of vascular bundles, which are situated one above another, which, independent one of another, are formed from the former, and are only cemented by anastomosis. A peripheral growth, in the manner of the *Monocotyledons*, does not take place internally nor externally, but a growth, progressing towards the axis, that is, a vegetatio terminalis. A peripheral vegetation, however, appears here, when both systems of vascular bundles are regarded in the relation of their development to each other; hence a vegetatio peripherico-terminalis takes place.

VII. *On the Structure and Growth of the Chenopodeæ and Amaranthaceæ.*—A double system of vascular bundles exhibits itself in these stems, an internal one, connected together through the entire stem, and situated in the pith or at its edges, and an external system, likewise connected together through the entire stem, and which increases itself from the outside, forming, as it were, the wood. The two systems are perfectly different from each other in point of essential composition; but the internal system, which provides the appendicular parts with vessels, and the external system, which belongs to the stem, are both found in such a way, that (excepting that each vascular bundle enlarges itself to a certain extent in its diagonal towards the outside) only one uniform progressive growth towards the upper end can be perceived. The type of a vegetatio peripherico-terminalis is, however, also manifest here, if we regard the fact, that the stem, through the agency of the continual formation of new layers of wood, grows towards the outside.

VIII. *On the Structure and Growth of the Arborescent Dicotyledons.*—The author infers, from the examination of young willow twigs, that the vascular bundles, which contain the vessels of the medullary sheath, correspond with the central system of vascular bundles of the herbaceous *Dicotyledons*, only with this difference, that the cardinal vascular bundles seem to be wanting in the system of the latter, whilst they maintain a distinguished position in the former plants. The real woody substance is formed here, as well as in the herbaceous *Dicotyledons*, by a peculiar system of vascular bundles, having nothing to do with medullary sheaths, and forms a mass, which, by means of prosenchymatous wood cells, possess a tendency to increase from within outwards. For the better explanation of the whole, I will add to the preceding, one sentence from the author's general inferences:—In all plants provided with vessels, there are only three kinds of vegetation;

1st, The vascular bundles of the stem extend themselves, in their development, towards the upper part of the stem, without multiplying themselves; and by this mode of growth, produce additions to the point or the end acrogenous growth (vegetatio terminalis), as is seen in the *Cycadaceæ* and Ferns. 2d, The vascular bundles of the stem have only a certain length, and the stem is enlarged and lengthened by new vascular bundles, which are added to those already existing, and attach themselves to those on the outside and over them; this produces the endogenous growth (vegetatio peripherica). Finally, A third kind, which is perfectly distinct from the two preceding kinds, and which is distinguished by the circumstance, that the vascular bundles do not only extend themselves towards the upper end, but at the same time towards the outside, which occasions the formation of a central and peripheral system of vascular bundles. This kind of vegetation is exogenous (vegetatio peripherico terminalis).

IX. *Anatomical character of the Cambium Layer.*—The author here particularly alludes to the growing together of the cells; he believes, that this may be best observed in the lower plants, as in the *Algæ;* and by researches on the subject, combined with other circumstances, he has come to the conclusion, that the increase of the cellular tissue is principally effected by division.

Every attention is due to the researches of the author, but, in my opinion, he has overlooked many things. It is, in the first place, indispensably requisite, to distinguish the different kinds of stems, if we wish to obtain a correct view of the structure of the stem. In relation to the researches of the author, two kinds may be mentioned:—First, *The Genuine Stem* (caulis genuinus), which continues to grow by means of buds, so that the buds extend themselves in length, and the leaves being in the course of development pushed asunder, the lowest leaves, or even the covering leaves (tegmenta) of the buds fill their places. This kind of stem is peculiar to all *Dicotyledons*, if we except the stemless plants (*Pl. acaules*), to the grasses, the *Smilaceæ*, and some of the palms. Most of the palms, the *Dracæneæ*, the *Pandaneæ*, many *Aloineeæ*, and similar plants, have such a stem. The author has overlooked the circumstance of the increase of the pith in the growth of the genuine stem, which always precedes the growth of the bud; and, indeed, almost forms the latter in its first state. Spiral vessels grow subsequently, and attach themselves to the older vessels of the stem, and to the internal vessels which are in contact with the pith. It is, however, not correct, when the author compares the medullary sheath of most of the *Dicotyledons* with the central system of vascular bundles of the *Piperaceæ*, *Nyctagineæ*, and *Amaranthaceæ*. The latter plants, in their infancy, have only a circle of vascular bundles, which grow outwards by means of spiroids and prosenchyma, and frequently also laterally, for the eventual purpose of forming a ring of wood. It is not always the case, that the lateral growth produces a genuine ring, but gaps remain between the vascular bundles, as in the *Umbellatæ*, *Cruciferæ*, and some others; the *Amaranthaceæ*, however, are different, as also *Monocotyledons* generally. They have, even in their very first days of growth, several rings of vascular bundles, of which the external one developes itself into a woody ring. The author has taken notice of the entangling of the vascular bundles in the nodes in the stems of the genuine *Monocotyledons*. I have caused this to be represented, in the Icon. Anat. Bot. part i. t. 2, f. 5, 6, I flatter myself, with accuracy. The author also has observed the growth of the vascular bundles in the cauloma. The taking the *Algæ* as examples of the growth of the cells, appears to me to be calculated to occasion errors.

Perhaps I may be permitted to make a few remarks on *the formation of layers in the Dicotyledons*. It is a well known fact, that letters, carved figures, and foreign substances, are frequently met with in the very middle of trunks. I found such letters in a lime tree near Berlin, on an estate belonging to the deceased minister, Count von Lottum; the letters on one side of the split piece were hollow, as represented, Icon. Sel. Anat. Bot. part ii. t. 2, fig. 7, on the other elevated, and the cavity had evidently been filled up again with a woody substance, as exhibited in fig. 3. This filling up substance, on making a transverse incision, exhibited rather irregular layers, with a moderate magnifying power. It appeared as seen in fig. 9; and on being magnified by 315 diameters, it evidently consisted of strata of larger and smaller cells, partly filled up, partly empty, with interstices, as seen in fig. 10. The circumstance, however, which appears particularly remarkable, is, that the internal structure of the filling up substance, as exhibited in fig. 11, on a longitudinal incision, corresponded very nearly with the old wood, fig. 12, situated next to it, with the difference only, that spiroids existed in the former, which were entirely absent in the new wood. It will be seen, therefore, that the formation of layers is peculiar to the wood, and is by no means caused by any external influences.

A treatise of D. Don, on the *Cycadeæ* (Annals of Natural History, vol. v. p. 48), was read at a Meeting of the Linnæan Society, in January, 1840. The author states, the stem in the *Coniferæ* exhibits the formation of other *Dicotyledons;* the annual zones are distinctly marked, and a distinct separation is also seen between wood and bark; this is not the case with the *Cycadeæ.* They resemble the *Monocotyledons* in this respect, but are distinguished from them in others. *Cycas* has, besides a large central pith, several thick, concentric, developing layers of cellular and fibro-vascular tissue; in *Zamia* and *Encephalartos*, there are, besides the pith, only two very thick layers, an internal layer of fibrous tissue, and an external layer of cellular tissue. The *Cycadeæ* do not share the peculiarity of the wood of *Coniferæ,* which consists of parallel regular dotted tubes; but there are, in it, dotted, reticular, and spiral vessels, besides slender transparent tubes, which are without dots or any other distinction. The dotted vessels of the *Cycadeæ* certainly resemble the same tissue of the *Coniferæ,* but the dots are placed much more irregularly, not only in different vessels of the same bundle, but also in different localities of the same vessel. Their form is oblong or elliptical in *Cycas revoluta, glauca,* and *speciosa; Zamia furfuracea* and *pumila;* as also in *Encephalartos horridus* and *spiralis;* but sometimes they are longer, smaller, and almost lineal, giving the vessel the appearance of being striped across. The dots are always arranged in the diagonal direction. The dotted vessels in *Zamia furfuracea* and *pumila*, may be unrolled spirally, in the shape of a ribbon, as in the ferns; the act of unrolling takes place in the direction of the dots, and from the right towards the left. Other vessels, which differ but little from the spiral vessels, excepting in their tendency to unite themselves in their windings, are to be found in all *Cycadeæ*, besides the dotted vessels. The spires in some vessels are free, and the fibre frequently exhibits, at various places, slits or little branches; the spires, in other cases, unite on one or on both sides, in which case the vessels exhibit a series of rings or bars; the fibre, in that case, is difficult to be untwisted, and frequently breaks off in the ring, or the bars separate themselves at the points where the spires unite, which usually takes place on the perpendicular sides of the vessel. The vessels, in other cases, are reticular, and as such there is a great analogy between them and the dotted vessels in *Cycas revoluta.* All these modifications are frequently exhibited in the same vessel, in *Zamia furfuracea* and *pumila*, which proves the correctness of Meyen's theory, who reduces all these vessels to one type. The dots and bars are evidently the thinnest parts of the tube, and probably remnants of the primitive membrane of the cell, which has remained free from the subsequently deposited material.

The cellular tissue of the *Cycadeæ* consists of a pretty regular parenchyma of prismatical hexagonal cells. The walls of the cells, in the above mentioned species of *Zamia* and *Encephalartos*, appear uniformly thick and transparent, without dots, but the walls of the cells, in the old stems of *Cycas revoluta*, are provided with numerous elliptical oblique bars, dots, or spaces, where the membrane is so extremely tender and transparent, that the cells seem to be perforated, the interstices being covered with an incrusting material, in the form of bands, that run one into the other. The extraordinary tenderness and transparency of the dots, or of the interstices, of whatever shape they may be, seem to afford evident proof, at those places where they are not covered by the incrustation, that they are derived from the original membrane of the cell. Tincture of iodine renders the membrane opaque, which evidently shows, that the interstices have no openings. The bands are evidently the result of a partial conversion into wood, and, indeed, no better instance can be given, to illustrate and confirm the correctness of the view which Schleiden has given of the origin of the bands and fibres in the vessels and cells, than the *Cycas revoluta.* The author being anxious to ascertain whether the bands already existed at a former period, examined a young undeveloped frond, about two weeks old, and was glad to find his opinion confirmed; the cells were of a uniform transparency, and exhibited neither dots nor bands, but had a distinct cytoblast or nucleus, which had entirely disappeared from those cells in which the incrusting material was observed; which proves, that this incrusting material had formed itself at the expense of the nucleus. The material which forms the band is connected, and has evidently not been produced by a growing together, as one might suppose, for it is perfectly solid, and exhibits no disposition to unroll itself, or to degenerate into fibres. The bands were probably produced by the circumstance, that the incrusting substance, which first flowed over the walls in a liquid state, contracted itself, and by the mere effect of condensation, supported by the distention, and probably the enlargement of the cells, naturally left parts of the primitive membrane uncovered. The author, however, notwithstanding the analogies exhibited by the reproductive organs, considers the relationship between the *Cycadeæ* and the *Coniferæ* very remote, and supposes the *Cycadeæ* to be the remnants of a class of plants which belonged to a former vegetation.

The description is accurate and striking, and his conclusion, that the *Cycadeæ* has but a remote relationship with the *Coniferæ,* ought to be well considered by those who assimilate these two natural orders with each other. A similar analogy takes place among the *Orchideæ* and the *Asclepiadeæ* with regard to the fructification, and yet no one will be bold enough to place them under one head in the natural system.

The approbation which the author gives to Schleiden is unwarranted, for Schleiden does not say that which the author ascribes to him. According to Schleiden, the cytoblast produces other cells, which come forth when the mother cell is absorbed. I also beg to state, that Mr. Quekett mistakes Schleiden's meaning, when he asserts (Annals of Natural History, vol. v. p. 66), that vessels are produced from a cytoblast in a similar manner as the cells. The vessel at first can, with difficulty, be distinguished from a cell, but it soon lengthens itself, and the cytoblast disappears. Mr. Quekett supposes the fibres to be produced from small granules in a gelatinous mass, which granules join each other according to the different formation of the vessels. There is much more in Mohl's opinion which D. Don's observations favour. Meyen, however, was not the first who reduced the dotted, the reticulated, and the spiral vessels to one type.

I have endeavoured to illustrate the structure of the *Cycadeæ* in the Icon. Select. Anat. Bot. part ii. (1840), t. 1, more with a view to determine their position in the natural system, than to investigate the formation of the separate cells and vessels. A cauloma, from a withered *Encephalartos, Friderici Gulielmi III.*, served for the purpose of examination. A longitudinal incision through this cauloma is represented in fig. 1, one half of its natural size—a part of this incision, in natural size, in fig. 2. A large pith in the centre, a thin layer of wood, which forms a perfect circle, and a rather thicker bark, will immediately be distinguished. Thus far the structure appears to be very similar to the structure of the stem of the *Dicotyledons*. But, on more particularly observing the bark and pith, there will occasionally be seen curved bundles of wood in both, which, on being magnified at 82 i. d., are seen as bundles of spiroids both in the bark, fig. 3, and in the pith, fig. 6. Such a formation is quite foreign to the *Dicotyledons*, and as the longitudinal incision cuts through the woody bundles in various ways, it readily suggests the conjecture, that they may, perhaps, form a net in both parts. This becomes evident, on observing a longitudinal incision of the wood, through the medium of a glass of low power, fig. 4, where the net of woody tissue extends itself just as much from the layer of wood, as in the nodes of the larger grasses, for instance, of *Zea, Mays,* and *Saccharum officinarum* (Icon. An. Bot. fig. 1, t. 2, figs. 5, 6); fig. 5 exhibits something of this entangling in the magnified degree of 82 i. d. The lower spiroids descend straight down, the upper make a curve towards the interior, and between them there is cellular tissue. A horizontal cellular tissue is also seen at g, like a medullary sheath, which has given rise to the conjecture, that the wood is produced here also from the cellular tissue, and that, by growing from the interior to the exterior, it compresses the cellular tissue. Every thing is the same here as in the *Monocotyledons,* the compound layers of wood, alone, are calculated to create doubts. We ought to consider, however, that the entire cauloma of the *Cycadeæ* is to be considered as a lengthened monocotyledonous node. In the second volume of the Icon. Anat. Bot. t. ix. fig. 1, I have caused a longitudinal incision of *Zamia Altensteinii* to be represented. The same kind of woody bundles, exhibiting a similar net as those possessed by *Encephalartos,* are also seen here. The spiral vessels of these bundles are represented, in a magnified degree, in fig. 2. The circular layer of woody bundles is not so developed in these *Cycadeæ* as in *Encephalartos, Fr. Guil.*

The leaves of the *Cycadeæ* have a peculiar character. They are jointed at the base, that is, they are seated upon a stalk, from which they fall off, as soon as the stem or they themselves begin to wither This stalk is of the same thickness as the lower part of the leaf, and exhibits, externally, interruptions towards the end where it is joined to the leaf, which, however, do not extend themselves into the interior. Other leaf-like parts are found beneath these leaves, one such part being under each leaf. See Icon. Sel. part ii. t. 1, s. 1, 2, and t. 2, s. 1, 2. If now we should assume, as a general law, that the branches issue forth from the axil of a leaf, and are, therefore, supported by leaves, that two genuine leaves are never seated one under another, or that one leaf is never situated in the axil of another leaf, we should, in such case, have to consider those parts of the *Cycadeæ* which are usually called leaves, as branches, and the leaf-like parts under them as genuine leaves. The term fronds, which Miquel gives to these leaves, in a recent treatise respecting the *Cycadeæ,* is very suitable, because it represents a sort of intermediate state between leaf and branch, like the fronds of ferns. Miquel, indeed, seems to have derived the expression from the latter. The leaf-like parts might be termed squamæ foliares. Such, for instance, occur in the *Asparagus,* where the so called leaves ought to be considered as barren flower-stalks. There are also squamæ foliares beneath the so called leaves of *Ruscus, Phyllanthus,* &c.

Some remarks by George Gardner, *on the Structure of the Stems of Palms,* may be found in the Annals of Natural History, vol. vi. p. 57. The author refers to a sentence in Lindley's Introduction to Botany, where Lindley states :— " The investigations of Mohl appear to show, that this view of the structure of endogens requires some modification. According to this observer, every one of the woody bundles of a palm-stem originates in the leaves, and is at first directed towards the centre; arrived there, it follows the course of the stem for some distance, and then turns outwards again, finally losing itself in the cortical integument. In the course of their downward descent, the woody bundles gradually separate into threads, till at last the vascular system, which for a long time formed an essential part of each of them, disappears, and there is nothing left but woody tissue. In this view of the growth of endogens, the trunk of such plants must consist of a series of arcs, directed from above inwards, and then from within outwards; and consequently the woody fibres of such plants, instead of being parallel with each other, must be interlaced in infinite intermixture." Lindley, farther on, enumerates some difficulties with which the formation and the direction of the woody bundles, in reality, according to Mohl's statement, would be attended. Gardner, when travelling in the Brazils, caused a palm tree, which is called *Coqueiro* by the Brazilians, to be split, and in the trunk he found very large woody bundles, which were readily traced. As soon as they come from the leaves into the trunk, they make a gentle curvature of about 18° downwards and inwards, until they nearly reach the centre of the column; they then change their direction, and turn downwards and outwards, with a greater obliquity than before, until they have nearly reached the external surface of the trunk; they now descend downwards in a line parallel with the axis, until they at last get so much ramified as not to be followed further. Lindley, as above stated, found the first difficulty in Mohl's statement to be this, that the lower part of the trunk is, as it were, obstructed by the woody bundles, and must, therefore, unquestionably be equally hard. Gardner, however, asserts, that the woody bundles of the upper leaves do not descend quite down to the bottom, so that the lower as well as the upper part thus retain an external hard and an internal soft part. Lindley further says, the lower part of the bark must be much harder than the upper, because a greater quantity of woody bundles are there met with. That indeed is the case, replies Gardner, and every Brazilian knows it. Lindley says, thirdly, The hardness of the external part of the trunks of the palms cannot originate in the pressure of a new growth from the interior towards the exterior, but from a cause which would correspond with the production of the heart wood in the exogens. Is there such a cause, he asks, in the endogens? Gardner replies, The woody substance in the endogens is evidently produced from the leaves, and from this it may be inferred, that the same is the case with the exogens, as Du Petit Thouars has already asserted. The only difference appears to be this, that the woody fibres, in the exogens, remain between the bark and the last layer of wood; while, in the palms, they turn downwards and inwards, then gradually downwards and outwards, and finally descend parallel with the axis.

The remarks of Mr. Gardner appear to me to be, upon the whole, very correct. There is another difference to be observed, namely, that the trunk of the palms forms itself solely from the leaves, whilst other trunks do so from buds from which branches are developed.

Contributions to the Anatomy of the Cactaceæ, by M. J.

Schleiden, is the title of a treatise which was read to the Academy of Sciences at St. Petersburgh, in 1839, but which was only published at a subsequent period. The author first speaks of the parenchyma of the pith and bark, and says :—The cells are almost all globular or elliptical; the connection between the separate cells is so loose, that they are generally torn asunder by one incision, so as to render it a rare occurrence to see a cell which has been cut through. The sap, which in its youngest state always occupies the intercellular spaces, retires during its gradual drying up into the commissures (*Fugen*), and there forms a slight distention, filling up the vicinity of two cells. On the cells being separated, as described, the point of contact exhibits itself as a circle or ellipsis, surrounded by a slight elevated ring. Meyen has delineated these round circles from the *Oncidum juncifolium*, in which plant such a loose cellular tissue likewise occurs, and considers them, wrongly, as it appears to the author, large pores. The author has convinced himself, by researches and comparison in an infinite number of cases, that all porous canals proceed from the primary cell-wall; and if they do not seem to reach as far as that, they are then only fragments of a canal which has been cut through. Such perfect canals are, however, never seen to terminate in an intercellular space, nor even upon a part of the cell-wall, which confirms Mohl's view. The contents of the cells of parenchyma, always consist, in the first instance, of mucus in little globules, or of starch, both almost always covered with chlorophyll. It is of frequent occurrence amongst the *Cactaceæ*, that the starch is the bearer of the chlorophyll; and, in this instance, it may readily be observed, that the starch, after having been liberated from the chlorophyll through means of alcohol, is always a long time before it acts upon iodine, as for instance, in *Opuntia brasiliensis*. Besides the ordinary cells of parenchyma, we also find, in very many *Cactaceæ*, cells of two or three times the size of the former, distributed in the bark as well as in the pith, which are entirely filled with vegetable mucus. This mucus has also a kind of organization. It forms a globule, and is very finely marked on the surface with small furrows, similar to what in art is called "en vermeil." The different crystalline forms of oxalate of lime, as found in the *Cactaceæ*, are stated. The author found, in 100 parts of the perfectly dry vegetable substance of plants, 85.57 of oxalate of lime, 5.75 humic acid, 7.79 vegetable fibre, and 0.92 loss. The *Cactaceæ* frequently contain carbonate of lime, besides oxalate of lime, and that often in perfectly formed "rhombohedrons," as, for instance, in the *Cerens triangularis*. The opinion of the author, that young cells form themselves from a cytoblast, and then make their appearance after the resorption of the mother cell, he endeavours to prove by observations made on very young bulbs of *Georgina*, where two cells develop themselves from a cytoblast in one mother cell. The author then proceeds to treat of the external layer of the bark, the epidermis, and the outer bark. He says, besides the ordinary bark-parenchyma, we meet with, in the one-year-old shoots, beneath the epidermis, in almost all plants, particularly of those which convert themselves into wood, a more or less thick layer of peculiar cells, the walls of which are in a different chemico-physical state to those of the ordinary cell-membrane of the parenchyma. This tissue contains most water when in its youngest state, and is almost identical with vegetable mucus; it hardens subsequently through the loss of water. The cells at first have thin walls, but thicken in their gradual development, but owing to the gelatinous quality of these walls, it was impossible for the author to distinguish layers; but pores presented themselves, which may here be observed to particular advantage. The various changes of this cellular tissue are given. The commencement of the formation of the outer bark, or rather of the formation of the cellular layer, consists, according to the author, in the fact, that a darkish, yellow-brown, granular mucus matter collects itself in a certain locality in some of the epidermic cells. This substance gradually increases, till it bursts the sidewalls of the cells, and raises the upper walls, which are connected together in a continued membrane, whilst the lower walls remain firmly combined with the layer of bark situated beneath. In the third place, he treats of the wood. There is nothing more easily seen, says the author, in the *Monocotyledons* with shortened internodes, than that the older vascular bundles cross (in their peripheral course) the younger vascular bundles, which are situated towards the outside, and thereby form a longer or shorter curve. This is more difficult to observe in the *Dicotyledons* generally, but is easily seen in some of the *Mammillarias*. Here is found the curved course of the fibres, the crossing, and, in short, every thing that has erroneously been considered as a peculiarity of the monocotyledonous stem. Lastly, he gives the history of the formation of the wood. The inner cells, a small bundle of the yet tender cells, cease to develop themselves, and begin to form thickened layers by spiral deposits. The cells are extended in length by joining the adjacent distended cells, and frequently so much so, that the cell-membrane dries up and is absorbed, so that the spiral fibres frequently get into the intercellular spaces, as is often seen in the *Cactaceæ*. The spiral fibres are subsequently converted into rings, by a regular and gradual distension. The cells of woody fibre extend themselves longitudinally, and when this extension no longer corresponds with the extent of the whole plant, they are then compelled to force themselves with their ends between each other, and as it were, to grow into the intercellular spaces of the other tissues. When the formation of cells ceases in the internode, it nevertheless still continues in the cambium in the *Dicotyledons*. The cells form themselves into two or three very unequal parts, to which a fourth is sometimes added. The largest inner part forms wood cells, the external (third if existing) remains partly parenchymatous, and partly forms itself into cells of the liber, whilst the walls of the cells of the central portion (or, if the former is wanting, the external) remain quite tender and capable of propagation, and form the new cambium. The continued growth of the cambium is best observed in the *Cactaceæ*. Cytoblasts form themselves in the lowest cells of the cambium, and those small and tender cells grow upwards through the whole cell. Their contiguity to the next upper wall occasions the same process of growth, and thus it continues. The spiral-formed layers are seen at an early period. Finally, the mother cells are perfectly absorbed, the inner cells becoming wood cells, the external, cambium, &c. Another process yet takes place during the production of lateral anastomozing branches; a cloudy, slimy, gummy liquid is produced in a certain series of cells of the parenchyma, from which a layer is precipitated, by which the parenchymatous cell is converted into a spiral or reticulated fibrous cell.

I have endeavoured to represent the theory of the author in the context, and have mentioned, that I consider the doctrine of the cytoblast as the producer of the young cells in a mother cell, the latter of which is finally absorbed, as a mere hypothesis, founded upon imperfect observation. I do not know of any profound observer who has adopted it. Foreigners, when talking of cytoblasts, merely mean the nucleus in many cells, the existence of which no one denies; they never allude to the mother cell. An example of it has been given above. Schwann has adopted Schleiden's views, and applied them to the animal world. I think, perhaps the animal cell, in this respect, may be formed in a way exactly opposite to the vegetable cell.

It has always been a question, whether the spiral vessels are air tubes, or whether they carry the juices for nutrition? I myself have twice changed my opinion regarding it, because it was more my object to arrive at the truth than to insist upon being right. Dr. Schleiden despatches this question very quickly. He says, " I found, almost without exception, in all *Cactaceæ*, that the vessels, as they issued from the cambium, were filled with air. Indeed, I must confess, that I cannot conceive how any one, who has examined a great number of plants with attention, and only applies sound logic, can set up the doctrine, that the spiral vessels, and the woody fibres associated with them, are intended to carry fluid. Never and nowhere is a fluid found in them, excepting during a short time in the spring, in the forest trees of our own climate, which may be accounted for very simply, by the superabundance of the rising sap, and the permeability of the cell-membrane, and which, being only a periodical phenomenon, belongs as little to the usual course of vegetation, as the human uterus can be said to be a blood vessel on account of its menstruating. A considerable quantity of fluid flows out rapidly from the cut stem of the *Hoya carnosa* in our hot-houses, but the microscope instantly shows, that all the spiral and porous vessels carry only air."

The answer derived from the rapidity of the flowing out of sap is not worth much; for every Botanist knows, or may readily convince himself, by placing a slice of a potato under the microscope, and adding a drop of tincture of iodine, when it progresses as rapidly through the walls of the cell as on the table, therefore the living membrane of the cell offers little or no resistance to the absorption of fluids. In the same way as inorganic substances are permeable (most of the perfect crystals, at least of the alkalies and earths) to the imponderables, light, warmth, &c., so also is the organic substance permeable for fluids. It is not the passing through of a fluid, which is the effect of a vital power, which requires explanation, but quite the reverse; it is the retention of the fluids in certain cells, which either originates from a particular organization, as in the epidermis, or from the difference of the medium on both surfaces (air and fluid), as, for instance, in the air cells, or from peculiar organic powers, as, for instance, in the cells with coloured juices, existing between the cells with uncoloured juices.

Since the lifeless vegetable membrane retains fluids, the most simple method is to attribute this as a primary quality also to the living membranes, and to search only for particular powers when they allow a fluid to pass through them. The juice which flows from the *Hoya carnosa*, comes from the proper vessels, sap vessels, the same as the milky juice in the *Asclepiadaceæ*. These vessels generally, however, have no partitions. If, then, the nutritive sap made a rapid transition from the spiral vessels into the cells (withered twigs, for instance, placed in water, very quickly erect their leaves), would it be seen? But this is not the place for the investigation of this subject; it was only necessary to give Dr. Schleiden's statement in his own words.

Delineations of the internal structure of some *Cactaceæ* are represented in the Sel. Icon. Anat. Bot. part ii., tab. 3. The woody bundles in the stem of *Epiphyllum phyllanthus* are separated from each other at the points, where the stem has still its round form, and each bundle is surrounded by its alburnum, upon which follow the liber, separated in the same manner, and surrounded as usual by the bark, and opposite the woody bundles (see fig. 1). The alburnum consists of very tender small cells of parenchyma, the liber of very thick walls, or finely punctated liber vessels, rarely with partitions, but they are found in some (fig. 2); ramified, frequently reticulated spiroids are seen in the flat part of the stem, which are inclined towards the spot where the tufts of thorns are seated (fig. 3). The leaf, therefore, seems really to be transposed into the wings of the stem, for such a separation of vessels is not found in the stem of the *Dicotyledons*, nor in the stem of the same plant where it is round.

The internal structure of *Opuntia vulgaris* is likewise represented. A similar division of the spiroids towards the thorn tufts is likewise seen here, as in the flat part of the trunk of *Epiphyllum phyllanthus* (fig. 4). The joints of the stem or branches of the *Opuntiæ* are perfectly compressed, and that in such a manner, that the woody bundles are situated remotely from each other (fig. 5). Where the stem of the *Opuntiæ* is round, there it has the internal structure of the *Cactaceæ* in general, a thick bark, and woody bundles separated from each other (figs. 6, 7). The spiral vessels and spiroids also ramify towards the tufts of thorns in the *Cereus flabelliformis* (fig. 9); the fluid distension is, however, principally owing to the enlargement of the bark, which is much thicker than the pith (fig. 9).

Decaisne, in his Mém. sur le Developement du Pollen, de l'Ovule, et sur le Structure des Tiges de Gui, Bruxell., 1840 (Exte. du t. xiii. de l'Academ. R. de Bruxell.), has communicated some observations *on the Stem of the Mistletoe* (*Viscum album*). He first alludes to the remarks made by De Candolle, Kaiser, and Dutrochet, respecting it. Dutrochet asserts, that each joint of the stem grows independent of another; that the woody substance of each joint is separated from the other by a layer of cellular tissue; and that the joints are only connected with each other by the bark. Decaisne, on the other hand, says, that on the contrary, the bark vessels are not connected with every joint, and that the latter, on that account, readily separate from each other, but that the woody bundles are not separated from each other at the nodes; he failed to detect a layer of cellular tissue between them. Eight bundles of long fibres, he says, are observed about the pith, which exhibit all the characteristics of liber; these bundles correspond exactly with the internal part of the woody bundles, and next to them, and even in the wood itself, ringed vessels are found, which here seem to occupy the place of the spiral vessels. These ring vessels have escaped Kaiser, at least he does not speak of them. The mistletoe has no genuine spiral vessels, nor are there any traces of a membrane by which they are connected, nor are such vessels found in the nerves of the leaves. The number of woody bundles is constant in the young twigs, generally eight, seldom seven or nine; each bundle consists of three zones, the most external belongs to the liber, or to the fibrous cells of the bark, the second to the wood, and the innermost is formed like the external.

What the author calls ring vessels, *vaisseaux annelés*, are not generally so called; there are genuine spiral vessels, the spires of which do not join one another, and in which the membrane enclosing them can be distinctly perceived. Many Botanists would certainly not agree with him in the supposition, that there are spiral vessels which are entirely deficient of that membrane; and it is still less correct, to assume that circumstance to be a characteristic sign of spiral vessels. The more or less closely connected spires are likewise of no particular importance, and deserve as little to be ranked among the characteristics of spiral vessels. The substance which the author calls liber, certainly seems to deserve this appellation; the wood, however, in this plant is of a peculiar quality, which will be explained on another occasion, as we shall, further on, allude to the otherwise excellent researches of the author on the mistletoe.

In Froriep's Neuen Notizen, vol. xiv. p. 242, we find *Von Hall's Observations on the Increase of Trees in Thickness*, read at the Royal Institution of Sciences of the Netherlands, &c., first class. The observations were made on the oak, willow tree (*Salix alba*), Canadian poplar (*Populus monilifera*), horse chestnut, birch, maple (*Acer pseudo-Platanus*), lime tree, fir tree (*Pinus abies*), and the wallnut tree. I will pass over these observations, as the relative growth of these trees depends much on the soil in which they grow, and the observations only refer to trees in the same locality. The author has frequently made the observation, that the increase of growth, in point of thickness, is considerably lessened by the tearing off of the foliage, and the taking off of many and strong boughs, which is opposed to the opinion of the advocates of pruning trees. The author further instituted investigations on the increase of thickness in different months of the year. The tables on this point exhibit a proof, that the growth of trees in Holland is very variable, which no doubt is owing to the weather and temperature of that country. As a general rule, however, we learn, that the months of June and July are those in which the trees increase most in thickness, for the growth in these two months, in most cases, exceeded that of all the other months put together. The author did not observe a suspension of growth of trees from the latter half of June to the middle of August, as recorded by Duhamel for France; this is unquestionably owing to the fact, that there is no dry season in the summer in Holland. The opinion of Agardh is unfounded, that trees grow more in length in the first part of the summer, and more in thickness in the latter part of it. Trees do not increase in thickness during the winter months; the buds, however, thicken. The branches of birch, maple, and other similar trees, are seen to be filled with rising watery juices in March and April, if the weather is mild, which cannot be perceived so much, or not at all, as soon as the weather becomes warmer. These juices, however, have no influence whatever upon the increase of thickness in a tree. The superabundance of this rising juice decreases as soon as the leaves have perfectly shot forth, which seems, therefore, to be more concentrated in the leaves; and the growth of trees, in point of thickness, only commences after the leaves are capable of fulfilling their functions: this has been proved by all the measurements which the author instituted. The influence of the leaves upon the increase of trunks, in point of thickness, exhibited itself, among others, most distinctly in the Italian poplar. On one of these trees being deprived of almost all its branches, in the month of March, the increase in thickness was proportionably slight during the months of June and July. The growth of a lime tree, on the other hand, in which the side branches, also those lower down on the trunk, as well above as beneath the point of measurement, had, for the greater part, been purposely left, was considerable, and increasing every year. An experiment was made with two equal sized oaks, situated under the same circumstances, all the lateral branches were taken from one and left in the other; the result was, that the increase of thickness, in the tree which had not been pruned, was much more considerable than of the one which had been pruned. The trunks of *Monocotyledons* also increase in thickness according to the observations of the author. An *Aletris fragrans* had increased by 17½ millimeters in thickness in five years, and a trunk of *Dracaena draco*, by 23½ millimeters in the same period of time. These excellent observations confirm the theory which Thouars has advanced, respecting the increase of trees in thickness, which I have endeavoured to represent, at least in its principal features, in the elm. Phil. Bot. ed. 2, vol. i. p. 260, and in the Icon. Anat. Bot. part i. p. 7, fig. 10–12.

In addition to the account formerly mentioned, of the dying of wood, and rendering it durable, by Dr. Boucherie, we have now to add the Report of the Commission of the Academy, consisting of Mirbel, Arago, Poncelet, Audouin, Combey, Boussingault, and Dumas (Compt. Rend. 1840, vol. ii. p. 894). It is not necessary, they say, that the tree should have all its branches and all its leaves, it is only requisite to leave a tuft at the point, in order to effect the imbibition. It is not requisite that the tree should remain standing, it may be cut down, after having previously taken away all its useless boughs, and must then be placed with its lower end immersed in the fluid which is intended to be absorbed. If it should not be desirable to cut down the tree, it is only necessary to make a hole in the trunk below, or to make an incision with a saw, and then to bring the fluid in contact with it. The permeating of the stem is effected in a few days without difficulty or labour. In order to make the wood more durable and harder, pyrolignite de fer should be made use of for imbibition. The pinewood acid is brought into contact with iron shavings, the combination takes place even in the cold, and then contains much of creosot; and the latter, as is well known, is a preservative of all organic substances. In order to prevent the warping of the wood, Boucherie uses chloride of lime, or the lye of the places in which salt is prepared. It has already been stated, that wood may be died by causing fluids to pass into the tissues of trees, which, by their chemical effect upon each other, produce colours.

M. Payen has read a treatise at the Academy of Sciences in Paris, on the *Leaf-nerves of the Dicotyledons*, which has been criticised by De Mirbel; the critique is contained in the Annales des Sciences Naturelles, 2d Sér. Botaniq., v. 14, p. 220, and in the Comptes Rendus, 1840, v. 2. The treatise is praised on account of its practical applications. The author first considers the origin of the nerves from the vascular bundles of the wood in the branch, and enumerates three different kinds of origin;—1st, The unitary, if they spring from one vascular bundle: 2d, The ternary, if three vascular bundles unite in order to form the leaf-nerves; and, 3d, The circulary, if the vascular bundles meet from the whole circumference of the wood. The vascular convolutions frequently run through the petiole of the leaf to the leaf, without experiencing a change, but frequently each divides itself into three fibres, which then either enter into the leaf on the same surface as the principal nerve, or on different surfaces. The simple leaf is produced, if the central vascular bundle separates itself from the wood at an earlier period than the two others; if, however, the two lateral bundles liberate themselves first, then a *folium lobatum*, or *stipulatum*, or even *compositum*, is produced. If one of the two lateral bundles is separated earlier than the other, and earlier than the principal nerves, then the side of the leaf, where this happens, is always more developed than the others. If the curvature, which measures the distance of the central nerves to the side nerves, at that point of the branch where the bundles separate from the wood, is very large, then the leaf is generally lobed and stipulate.

The epilogue of Mirbel is singular. The labour, he says, was obliged to be done, it was necessary for science; it is well that it has been done with diligence. Good fortune has frequently a greater share in making important discoveries in the experimental sciences than cleverness. The phytologist, who has recourse to anatomy, can derive no more from the object than there is in it, however industrious he may be. M. Payen is not wanting in capability, he only wants the opportunity. Mirbel wished to say, What is the use of accuracy in research, if the variety discovered is not brought into combination with the whole? They are preparatory labours for the fortunate man who discovers their combination.

The Leaves of the Coniferæ appeared to me so remarkable, that I subjected them to an examination; the description of which is to be found in the Icon. Select. Anat. Bot. part ii. tab. 5, (1840.) They are principally distinguished by only having an ordinary simple (sometimes, however, perhaps a double) vascular bundle, which runs longitudinally through the leaf, without producing branches or ramifications. The *Folium acerosum* might be thus characterized. They generally also have one or two resinous channels, which run through the whole leaf; the leaves of *Abies balsamea* have them at the sides (fig. 9); the leaves of *Thuja occidentalis* and *Juniperus communis* (figs. 11 and 12), have only one resinous channel near to the principal nerves. Many have a double upper layer, as, for instance, *Abies balsamea* (fig. 9, *e e*), and *Juniperus sabina* (fig. 10, *c c*): the cells of some of them are also lengthened laterally, beneath the upper layer, as, for instance, on the upper surface of the leaves of *Abies balsamea* (fig. 9, *c c*). The form of the leaves of *Thuja occidentalis* is strange, the nerves are so ramified, not only amongst each other, but also with the branch, that only one woody bundle goes through the branch in the middle.

ROOTS AND TUBERS.

A Note upon the Anatomy of the Roots of Ophrydeæ, by John Lindley, Tr. of the Linnean Society, vol. xviii. part iii. p. 423. The author says, that the tubers which form the roots of many African *Ophrydeæ*, on becoming dry, have the appearance of sacs, filled with small pebbles; the surface is coarse grained, as if the epidermis was firmly contracted over hard substances. This may be seen particularly in the dry spindle-like roots of *Disa multifida*. On cutting across a fresh root of *Satyrium pallidum*, it will be seen distinctly whence this appearance arises. A great quantity of oval, tough, and solid nodules, clear as water, and frequently twenty times the size of the cells which surround them, are found in the tender parenchyma. These nodules may readily be separated from the cellular tissue in which they are situated, and they appear to be of an irregular polygonal shape, like polished stones of rock crystal. Their facettes are produced by the pressure of the cells of parenchyma between which they are situated. They are tough like horn, cannot be torn, crackle between the teeth like pieces of caoutchouc, may readily be cut even into slices, and then appear quite homogeneous; they do not exhibit any layers either in a fresh or dried state, or when treated with chemical reagents. They are generally of the same size, but some are not larger than the ordinary cells of cellular tissue. The nodules are scarcely soluble in cold water, but swell upon being boiled, and are partially dissolved into a transparent jelly, having the appearance of glass. On exposing them to the air, they rapidly become dry, and of a dark brown colour. The diluted solution of iodine does not perceptibly act upon them, but the tincture of iodine gives them a claret colour, on being previously treated with caustic potash, or nitric, or sulphuric acid. The diluted solution of iodine colours starch granules blue, but has not that effect upon these nodules; the tincture of iodine, on the other hand, gradually colours the nodules of an amethyst colour; they then become claret coloured, and, on an incision being made into them, this colour gradually distributes itself. These colours, however, soon disappear again, especially if there is a warm temperature; no trace of blue can be detected. The nodules, therefore, are not starch. The roots of all other *Ophrydeæ*, European or otherwise, which the author had an opportunity of examining, were formed, in every essential point of view, like those of *Satyrium pallidum.* The only points of difference presented, were the size and the shape of the nodules, and the relation which they bore to the surrounding cellular tissue, and the colour which the nodules assume when exposed to the air. On crushing the nodules, it was found that they consisted of very small transparent cells. The author endeavours to explain the reasons which induced Guibourt and Payen to describe the *Salep* as consisting principally of starch, and is of opinion, that they boiled the tubers of *Salep* and afterwards dried them again. By this process he supposes the starch to have been dissolved, and to have flowed over the nodules, thus rendering them incapable of being recognized. He adds, The principal characteristic of the tubers of *Salep* does not owe its origin to the starch, but rather to that gummy-like substance which for the present he would call bassorin. The remarks of the author deserve attention. It is well known, that the powder of the tubers of *Salep* swells in cold water, which granules of starch do not. Besides the starch, there is another substance likewise found in the tubers of *Salep* and other *Orchideæ*, which is not coloured blue on the application of iodine. This is found in the nodules of the author; into the investigation of this substance I did not enter at the time. Unformed starch, the same as if the tubers had been boiled, I have seen in the fresh roots of *Orchis latifolia*, which I have alluded to before. I must leave it open to discussion, as to whether the *Salep* roots, that are sold in the market, are boiled, and afterwards dried again.

FLOWERS.

M. Decaisne treats of the *Development of the Male Blossoms of the Mistletoe* in the above-mentioned memoir, respecting the pollen, the ovules, and the stem of the mistletoe. On making a transverse incision quite through a young flower, slices were obtained, which, in the same manner as the vessels, are separated into four divisions. A layer of cellular tissue forms the external circumference; this is followed by a green matter, mixed with granules, which have a strong molecular movement, and an uncoloured tissue is situated in the centre, against which the green matter makes four projections. The green matter some time afterwards was distinctly seen separated into four parts, each consisting of two halves, an external green half belonging to the calyx, and an internal paler coloured one from which the anthers were produced. The green part gradually increased, and shot forth prolongations into the inner part, which crossed through it. On examining each of these four parts separately, clearer spots were perceived in them, which were spaces filled with mucus matter; the cellular tissue which forms the walls of these spaces contains many small granules, and some of them also contain a nucleus of a lentil-shaped form, which the author calls a *phakocyst.** The mucus in the spaces, upon being submitted to a greater degree of magnifying power, subsequently exhibited round, transparent, large cells, which the author, as well as Mirbel, calls pollen cells (utricules polliniques). These pollen cells some days afterwards cease to be transparent, and one, or sometimes two, oval nuclei are formed, which consist of small granules. The pollen cells, about five days afterwards, become again transparent, the granules being concentrated in one mass in the centre. They are still surrounded by a mucus substance. Thus the pollen cells remain for some days; four phakocysts are subsequently discovered in the centre of the granular mass, each with a clear central point. The granular mass disappears after some time, without any of the phakocysts becoming enlarged. At last, in the middle of the month of August, four months after the commencement of the observations, the vegetable cells exhibit themselves as consisting of concentrated layers, with a cavity in the middle, in which the four commencements of the pollen grains appear surrounded by a liquid. They gradually increase in size, and the thick pollen cell, consisting of layers, finally disappears altogether. The pollen cells in the *Malvaceæ*, at least in *Hibiscus syriacus*, have already a considerable thickness, before we can perceive the commencement of the pollen grains, because the matter within them is clear as water. It only afterwards, when it forms new products, becomes granular, for the first traces of phakocysts are subsequently discovered in the granular matter. The granular matter subsequently separates itself into four masses, which contain a phakocyst; and a clear ring is seen round each of these four masses, which shows that they do not altogether fill up the pollen cell. The pollen cells have a covering, consisting of layers, like the starch granules, and they also shoot up in a similar manner, on placing them in a drop of water. The membrane of the pollen cells, according to the opinion of the author, is not produced from the internal surface of the pollen cells, The author adds,—"The anthers of all flowers first attain their essential characteristics, when the other flowering organs are scarcely perceptible. On rolling young pollen grains between two glass plates, their external membrane is not removed, but the granules are torn, and their phakocyst escapes; on the other hand, the external membrane of ripe pollen grains is easily separated, and the internal cell contains only granules, but no phakocysts."

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* From φακὸς, lentil, and χύστη, bladder. The name, says the author, seems to give a more correct conception of the characteristics, "sans rien prejuger de ses fonctions," than the term of Cytoblast.

IMPREGNATION—OVULE—SEED.

We shall here proceed with the researches, which M. Decaisne has instituted, respecting development in the mistletoe. On examining the ovary in its earliest state, it presents a uniform mass, with two small interruptions of the cellular tissue; the cells, however, soon unite again, in order to form a clear cellular tissue in the centre, surrounded by a green circle. No ovule is perceived in the ovary for a long time, not as far as the commencement of June, when the ovary has the thickness of a pepper corn. At a little later period, however, an ovule may be discovered; the easiest method of effecting which is, to separate the central substance into two parts, which is best done by gently drawing it to and fro. The ovule forms a club-shaped excrescence, the cellular tissue of which is arranged in concentric layers; each cell contains two phakocysts. On subsequently bringing the ovule, when it has assumed the shape of a small, rather compressed substance, in contact with a drop of water, the water will penetrate it, and drive out the phakocyst with some force. The application of a drop of tincture of iodine colours the interior yellow, but leaves the granules uncoloured, which only subsequently become coloured when iodine is applied. Two thin club-shaped bodies are found next to the ovules at this epoch, and some weeks earlier, three fibrous bodies, rather thickened at the end. The author considers these bodies as abortive ovules. The ovule, which is thin at the lower end, might be compared with an embryo sac, if the position of the surrounding vascular system, and the comparison with the other parts of the fruit, did not contradict it. The young embryo exhibits itself, as a small mass of cells, at the point of the ovule, and nearly in contact with what one might call the epidermis. The author never observed a trace of a pollen sac in the interior of the ovary, nor did he ever discover the slightest indication of a special integument for the ovule; so that the latter exhibits nothing more than a nucleus, as has been observed in the *Santalaceæ,* and even in the *Olacineæ.* This nucleus is attached, by its base, to the bottom of the ovary, and has its point exactly in the opposite direction, so that the ovule must be regarded as orthotropous. When the ovule has attained such a size that the embryo becomes visible, together with the fibre on which it hangs, it assumes a green colour, for it was previously uncoloured; and this green colour spreads itself from below upwards, as far as the embryo, which remains uncoloured. The starch granules also become larger, and almost entirely fill up the cells; but the phakocysts remain unchanged. Besides the green colour of the mistletoe seed, another circumstance has attracted the attention of Naturalists, namely, that two or three embryos almost always occur in one seed. The author was fortunate enough to observe ovules several times in various stages of growth, and saw that the union of the ovules commenced at the base and progressed upwards, by which, therefore, the polyembryony of the mistletoe became explained. The author never saw a cavity in the ovule of the mistletoe when the embryo was forming, neither did he ever find an embryo sac. The embryo exhibits itself, first, as already mentioned, at the upper end of the ovule or nucleus; and the embryo cell, or the young embryo itself, is subsequently seen to be attached to a series of cylindrical cells in the cavity of the ovule, which cells constitute a kind of umbilical cord, but without a vascular system.

Observations on the seed of *Loranthus aphyllus*.—A small conical mass is seen at the upper end, in a similar ovule to that of the mistletoe, which is more dense than the surrounding cellular tissue; from this substance issue four tender tubes, which twist themselves round each other, and, in a manner, form a spiral vessel, almost in the same kind of way as Treviranus observed in the ovules of *Abies*. An oblong body, the embryo, is subsequently produced at the lower end. If several embryos are existing in one seed, they always appear at the upper and lateral part of the nucleus. The separation of the embryos in the ovules is, in the first instance, caused by the united ovules being either of an unequal size, or by one growing more rapidly than the other. If the ovules are, however, of an equal size, the embryos then first turn themselves obliquely towards the axis of the nucleus, and afterwards, as soon as the cotyledonary ends touch each other, the latter turn round, and are directed towards the point where the ovule is attached. The author explains the circumstance of the embryo shooting forth from the nucleus, by supposing that the former, when in the act of enlarging itself, is forced out by the resistance of the already formed nucleus. The author never saw more than three embryos in one seed. He observes, that the circumstance of the fructifying fluid retaining its power so long can scarcely be comprehended, when the long interval is considered which intervenes between the opening of the blossom and the appearance of the embryo. This is observed in other plants; and Ad. Brongniart is, therefore, of opinion, that the embryo remains for a time in a sort of torpor before it developes itself. But, says the author, this cannot be applied to the mistletoe, because the ovules are not only not organized at the time of blossoming, but they have not even a cavity for the embryo. The author then makes some observations on impregnation in general. He says, pollen sacs exist in some plants; but in others, where papillæ are situated upon the ovule, as in the *Aroideæ*, they have never been observed, and the papillæ seem to be substituted for them; in other plants again, little bands (bandelettes) descend from the basis of the style, and are deposited in the seed near the micropyles; for instance, in the *Compositæ*, and in some others. Finally, he speaks of the position of the species of *Viscum* in the natural system; the author, with Robert Brown, places them in the *Apetalæ*, beside *Loranthus*, and next to the *Santalaceæ; Schoepfia*, however, must be separated from this, and placed amongst the *Olacineæ*. Three tables illustrate the researches of the author.

With this we must notice *Some further Words on the Act of Impregnation, and Polyembryony in the Higher Plants*, by F. J. F. Meyen; Berlin, 1842, vol. ii. p. 50. The author first details facts, and then argues against Schleiden's theory of the embryo forming itself from the pollen tube. The point of the embryo sac, according to his researches, combines itself with the pollen tube, and the embryo proceeds from this union, and, in many cases, appears as a double germinal vesicle. The observations related in this part of the treatise, were made upon the *Mesembryanthemum pomeridianum*, and may be considered as an epilogue to the statements made on this subject, in the third volume of the author's physiology. He then speaks of polyembryony, and gives a description of the development of the ovule in the mistletoe. There is no particular pistil, he states, in the mistletoe, and, therefore, likewise no real ovarium; the ovule is a mere naked nucleus, the point of which is free and projecting, and at the same time serves as a stigma, as it is the immediate recipient of the pollen. A cavity is produced in this nucleus, and within it the embryo sacs, of which there are often two or more, exhibit themselves in the middle of April. It is then that the embryo developes itself. The author did not observe any pollen tubes.

It is evident, that what the author terms embryo sacs, Decaisne describes as ovules. The examination of these ovules has been instituted with much greater care by Decaisne, and if Meyen had continued his researches long enough, he no doubt would have been convinced of his error. He likewise did not think of the pericarpium, nor of the berry. Meyen always aimed too much at novelty, at producing a striking effect, and endeavoured, in this way, to outdo his antagonists. This statement should be compared with the author's explanation of the peculiar position of the embryos in the mistletoe seed, when several of them occur in one and the same seed, in Wiegmann's Archiv for 1840, vol. i. p. 164, in which he has well observed the union of the embryos with their cotyledonary ends.

Goeppert enumerates an instance of polyembryony in *Thuja orientalis,* in the Report of the Labours of the Silesian Society for Native Culture, 1840, p. 99.

M. Arndt, of Osnabrück, has instituted observations (Flora, 1840, p. 477) *on the Impregnation of the Flowers of Lopezia mexicana.* The anther burst on the inside towards the stigma; the place where the anther-valve is about to open is indicated by a glittering longitudinal stripe. The bursting of the valve takes place when the petals of the corolla are still entirely closed, which is, however, perfectly developed in all its parts. After the bursting, the filaments increase in size, turn round and round, and finally throw off the emptied pollen tubes.

Remarks on the Impregnation of Plants are also found in the Journal de Pharmazie, 1840, p. 751, by M. Fromond; see also Flora, 1841, p. 204. He particularly treats of the cases where the stigma is situated above the anthers. The author is of opinion, that wind or insects are not always required to facilitate the impregnation; indeed, he does not even consider it philosophical to have recourse to these modes of explanation in such cases. Impregnation, according to the author, only takes place some time after the opening of the flower, and when the corolla twists itself on the approach of the period of withering. This is the case in *Iris*. The pollen here precipitates itself upon the basis of the style on the bursting of the anther; the parts of the flower afterwards become erect, and bend themselves towards the centre of the flower, and thus the pollen is sprinkled upon the stigma. The same process also takes place in *Sisyrinchium* and *Moræa*. The flower in *Ipomœa* and *Convolvulus* is twisted into a spiral form after the bursting of the anther, and completely encloses the style; the corolla is afterwards loosened at the base, and glides down on the style by the slightest motion of the air, and the pollen situated upon it thus comes into contact with the stigma. The anthers in the *Malvaceæ* strew the pollen about far and near in the morning, so that it is partially precipitated upon the petals, which latter are brought towards the centre of the flower in the evening, thus enabling the pollen lying upon them to come into contact with the stigma. Many flowers are twisted in a spiral form, so as perfectly to enclose the stigmas.

M. Treviranus made *Remarks on the Hairs on the Style of the Species of Campanula* (see Flora, 1840, p. 680), to the Assembly of Naturalists at Erlangen. He agrees with Ad. Brogniart in the opinion, that impregnation in these plants is effected in the usual way, by pollen tubes, which he found upon the stigma. Brogniart found that these hairs did not fall off, but drew back into a sheath, like the claws of a beast of prey; which Treviranus confirms. The latter found pollen-globules within the cavity of the hair itself; they therefore cannot have come into the hair accidentally, as Brogniart believes.

Treviranus has likewise observed, that a cavity is situated beneath these hairs, which penetrates into the style, without, however, communicating with the conducting cellular tissue.

The Style Hairs of Campanula medium have been represented in the Icon. Anat. Bot. tab. 21, fig. 1 and 4. It can be seen, that a channel enters from the hair into the style, without, however, being connected with the duct of the style. The drawing back of the hair I did not find; but it appears to me, as if the fore-part of the hair lost itself in and sunk into the lower. There were tubes similar to pollen tubes in the style, but forced together, and before the opening of the anthers (fig. 1). The duct of the style is closed below both before and after the opening of the anthers, but open above (figs. 2, 3). Pollen tubes were seen in the duct after the opening of the anthers, and differ from the lengthened papillæ with which I placed them in the explanation of the figures; they are also thus delineated, as the few papillæ strewed about in the duct may have got into it by the incision. It is singular, that pollen tubes should have been found in the duct of the style before the bursting of the anthers; but this requires further investigation.

Pollen tubes, in the state in which they penetrate the ovule, are illustrated in the Icon. Anat. Bot. part ii. (1840), tab. 8. The micropyle of the ovule of *Mesembryanthemum glomeratum* is much larger than the entering pollen tube (fig. 2), and no trace could be perceived of an opposing embryo sac, or of any other change taking place within. The same was also the case upon the penetrating of a pollen tube into the ovule of the *Hohenbergia bilbergioides* (fig. 3); each ovule in the ovary was provided with such a pollen tube. The pollen tubes of the same plant, as they are produced from the pollen grain, are represented, fig. 4, in which the perfect correspondence between the tube, which forces its way into the ovule, and the sac which has just been developed, may be observed. Fig. 5 exhibits two ovules of *Gymnadenia conopsea*, into which pollen tubes are entering. The integument of the ovule is so tender and transparent, that the absorption of the sac, as soon as it has entered, may be distinctly observed. The pollen tube does not always exactly hit upon the opening of the ovule; thus it is seen at the edge of the micropyle in fig. 6, in an ovary of *Matthiola annua.* The manner in which the pollen tubes penetrate through the cellular tissue of the duct of the style is represented in fig. 6, from *Nicotiana tabacum.* They take the shortest road to get from the cellular tissue into the cavity of the capsule; but no entering into an ovule could be perceived.

The Germination of the Orchideæ I have attentively observed in *Angræcum maculatum* and *Goodyera procera*, and it has been represented in the Icon. Anat. Bot. part ii. (1840), t. 7. That which I have seen is so different from the germination of all other *Monocotyledons*, and corresponds so exactly with the germination of the (bulbilli) bulbous buds which are found on many *Liliaceæ*, that I hold the seed of *Orchideæ* to be a bulbillus. It is well known, that the seeds of many of the species of *Pancratium* are converted into bulbilli, which, though not the same, is certainly a similar occurrence. For the sake of comparison, I have given, in the sixth table, an analysis of a bulbillus of *Lilium bulbiferum.* I had already kept the delineations of *Angræcum* for some time, which M. Schmidt had executed with his usual ability and exactness, but thought, however, that it was an accidental change of the seed, until I had an opportunity, not only of observing very accurately the germination in *Goodyera*, but also of observing that no contradictory circumstance is perceptible in the *Orchideæ* generally, which are already further advanced in the process of germination. The seed of *Angræcum* first exhibits itself with two points (fig. 1); from which, as subsequently seen, the stem and a small root develop themselves (fig. 2). On cutting through the seed, when in that state, longitudinally, a bundle of spiroids will be found in the centre of the cellular tissue, which occupies the whole seed (fig. 3). On cutting through the seed, bulbillus, or whatever one pleases to term it, after the germination, we find that it is but little changed, a bundle of spiroids is seen going laterally into the root (fig. 4). *Goodyera* is similar. The seed, after it has commenced to swell and to germinate (fig. 8), has its exterior shape in the same state as it had in the testa (fig. 7), proving that it does not experience any material change by germination, nor is it converted from a genuine seed into a bulbillus. It was impossible even for M. Schmidt, who certainly possesses great ability in making fine incisions, to do this with the seed when situated within the testa, but it was easily done in the seed which had just begun to germinate. A bundle of spiroids was likewise found to be here situated in the centre, and every thing else was filled up with cellular tissue (parenchyma). The cells in the circumference contained chlorophyll; the cells towards the centre, however, dark granules—phakocysts, as Decaisne terms them (fig. 10). A fine longitudinal incision was made, after the embryo had advanced so far as to exhibit two perfectly developed leaves (fig. 9). It exhibited little change from the former; the bundle of spiroids had enlarged, and separate vessels entered into the leaves. The number of the chlorophyll cells had rather decreased than increased, and the phakocyst had dissolved itself into small granules (fig. 11). Instead of a large root, as *Angræcum* exhibited, only fine root-leaves, which surrounded the nucleus, were found. On making a longitudinal incision through a bulbillus of *Lilium bulbiferum*, a bundle of spiroids will likewise be found in the centre of the cellular tissue, from which the separate vessels are given off upwards into the layers of the bulbillus (fig. 11). The only difference is found in the fact, that the seed of these *Orchideæ* is quite naked, whilst the bulbillus is enveloped in leaves, as may be seen in the transverse section (fig. 10). Three roots are always attached to the *Lilium bulbiferum* (fig. 12), which usually have a bundle of spiroids in the centre, without pith; spiral fibrous cells, however, are seen in the circumference, similar to those in the aerial roots of the *Orchideæ*.

ANOMALOUS PHANEROGAMIÆ.

A. PARASITES.

UNGER has made some excellent contributions to our knowledge of Parasitical Plants in the Vienna Archiv for Natural History, vol. ii. (1840). After having given a general sketch of the different opinions on parasitical plants, and of the literature of the subject, he proceeds to the different classifications of these plants. On commencing at the lowest of them, he states, we shall find the parasite united with the plant that gives it nourishment, in such a manner, that it shoots forth immediately from the wood of its supporter, and its vascular system anastomoses with the vascular system of the nourishing plant. This is seen in the species of *Rafflesia*, *Brugmansia*, *Pilostyles*, and *Apodanthes*, perhaps also in *Cytinus*. An immersion of one substance into the other, without any intermediate aid, is perfectly recognisable here; the lowest part of the parasite is, in a manner, wedged into the nourishing plant; its parenchyma exactly joining itself to the parenchyma of the bark of the nourishing plant, and the vascular bundles of the former are attached separately to the parts of the wood separated by the medullary ray. 2d, The parasite forms a sort of root-stock, by which it adheres to the nourishing plant, and from which it sends forth several flower stalks. 3d, A part of the vascular system of the nourishing plant is received into the root-stock of the parasite, and by means of an increased reaction (probably produced in the same way as germination), a substance is thus formed, which belongs both to the parasite and to the nourishing plant; *Balanophora*, *Cynomorium*, *Cynopsole*, *Sareophyte*, *Lophophytum*, and *Ombrophytum*. 4th, The parasite forms a root-stock, the fibres of which attach themselves to the nourishing plant; *Helosis* and *Langsdorfia*. 5th, No root-stock is formed, but strongly ramified roots, which are connected with the mother plant through means of papillæ; *Lathraea squamaria*. 6th, Inoculation of the parasite, as in number 1, but with the addition of roots, which are provided with papillæ, which soon disappear; *Orobanche*, *Phelipaea*, *Chonopholis*, *Hyobanche*, *Epipheagus*, *Æginetia*, and *Obolaria*. 7th, The bulb-shaped irregular substance, similar to a rhizom, from which the flower-stalks of these plants spring, consists of a bundle of intimately matted together root-fibres, which partly belong to the parasite, partly to the nourishing plant; *Monotropa hypopithys*. 8th, The parasite developes itself independently, and only here and there occasionally shoots forth from the stalk into the nourishing plant; *Cuscuta cassytha*. 9th, Strongly ramified roots, which extend themselves both over and under the bark of the nourishing plant, and are in a manner infiltrated into the same; *Viscum*, *Loranthus*, *Misodendron*, &c., &c.

The author has added many facts respecting the anatomy of these plants. Thick walled cells frequently occur in the form of bundles, which are longitudinally extended, and provided with partitions. The application of a strong magnifying glass distinctly exhibited thirteen layers in the *Helosia braziliensis*, and even thirty layers could be distinguished in the *Langsdorfia hypogæa*. The channels which cross through the layers in all directions, could also be distinctly perceived. These layers are very unequally deposited, and in such a manner, that one side appears free from deposit, whilst the other appears to have an accumulation of them. The vascular bundles of the *Rhizanthaceæ* may be considered as remarkably small and insignificant; they consist of only two vessels, and the thick walled cells accompanying them. The vessels, without exception, belong to the reticular, porous, and scalariform vessels, never to the simple or ring-formed spiral vessels. In general, the vessels of the *Rhizanthaceæ* consist of short longitudinal tubes in the shape of a leather pipe, which are irregularly placed one above another, and are placed in continuation with each other by the partial absorption of the intervening walls. We also perceive in the vascular bundles, especially in the *Cynomorium* and *Helosis*, that a peculiar homogeneous matter, which is soft and of a brown colour, is deposited in larger or smaller irregular bars and nets. The vegetation he considers to be his vegetatio terminalis, as exhibited in the ferns. They are not *Monocotyledons*. Independent of the circumstance, that no anastomosis of the vascular bundles takes place in the *Monocotyledons*, which is distinctly seen in the *Rhizanthaceæ*, there is another fact which is opposed to this supposed mode of vegetation of the vascular bundles, and that is, that the curvature towards the outside is never perceived. Observations are then added respecting the anthers of parasites. The club-formed swellings of the columna genitalis, in the *Pilostyles*, cover, at the lower side, from two to three rows of simple pressed tubes, flattened at the points. The anther, in *Brugmansia*, consists of four tubes; in *Rafflesia*, an indefinite number of long drawn tubes are found, which all bend together upwards, and scatter their contents about through a single opening. The anthers in *Hydnora* consist of longitudinal tubes, which open themselves longitudinally; an indefinite number of blunt conical tubes, entwined with each other and united into a little head, are seated on a thick foot-stalk in the *Sarcophyte sanguinea;* the upper free wall of these tubes bursts at the period of ripeness; the bursting is effected by the elasticity of striped vascular cells. The anther tubes in *Hydnora* have quite a similar structure. The author finally treats on the relationship of parasites with the fungi, with which they certainly correspond in many respects. The author's statements are illustrated by seven tables, which are a valuable contribution to our knowledge of these plants.

There is no doubt, that all parasitical plants belong to the *Dicotyledons*. The vascular bundles certainly do not often form a ring, but stand separated in one circle, which is also the case in many weed-like *Dicotyledons;* they are never, however, situated in several circles, as is the case in the *Monocotyledons*. I am not inclined to agree with the author, when he says, that the latter exhibit no anastomosis of the vascular bundles; this is frequently the case with the nodes of the grasses; the bending towards the outside is by no means a rule with the *Monocotyledons*. Many *Rhizanthaceæ*, according to the representation of the author, appear to have the structure of a root-stock; for instance, compare with them the root-stock of celery (*Apium graveoleus*). The thick walled cells most probably belong to the vessels or cells of the liber. The author, in this instance, also limits his conception of spiral vessels to such as may be unrolled, and which exhibit no membrane between the spires. I will not be positive that this membrane always exists, or that it is frequently wanting; but I have mentioned once before, that I would not like to consider it as a characteristic, nor even the circumstance of their being unrolled, for the latter may be occasioned by the stronger or slighter union of the spires themselves, or by the greater or less strength of the membrane between them. In my opinion, there are only two kinds of spiral vessels; one where the spiral-formed windings are exhibited in the form of a band, and the other where there are porous vessels with round holes or transverse bars. We have before noticed the treatise of David Don respecting the *Cycadeæ*, in which he says he had saturated porous vessels with tincture of iodine, and found that the openings were coloured; and thought this a proof that they were overspread with a tender membrane. I have frequently repeated this experiment since, but the result was just the reverse; the pores were not coloured at all, but were always distinctly seen as genuine openings. If Mr. Don did not see this, it must have been owing to his not having made sufficiently fine incisions, when, consequently, a membrane was left beneath, which closed up the opening. The circumstance of the bars being seen as dark stripes, originates in the reflection of the rays of light; this, however, is frequently so deceptive, that these bars may be considered as shortened spiral fibres or bands, as has occurred to myself and many others.

B. LEMNACEÆ.

Contributions *to the more intimate knowledge of Lemna arhiza*, by J. T. Hoffmann, Wiegmann's Archiv, 1840, vol. i. p. 138. The author found this hitherto but little known or neglected species upon waters in the south of Holland, near Gouda. It is distinguished by its form; it is oblong or round, almost flat above, but strongly arched below; it has no roots, and 0.05 inch long. A yellow spot is speedily discovered on the lower side, which rapidly enlarges itself, and produces a new plant, which remains combined with the mother plant for some time, so that the plants seem to be joined in pairs, but they are finally separated. This yellow spot, therefore, is a bud. *Lemna arhiza* floats about in this form, till the end of October or the middle of November. Dried leaves, intermingled with yellow granules, which latter are the winter buds, are then found in the mud of the ditches, upon which *Lemna arhiza* has been floating; these buds develop themselves in the ensuing spring. They are not so much distinguished from summer buds in *L. arhiza* as in *L. polyrhiza;* but they are smaller, of a yellower colour, and are triangular with rounded corners. These winter buds, in the other species of *Lemna*, are always without roots, and have, therefore, frequently been mistaken for *L. arhiza.* A slit is discovered, when more accurately observed, where the bud is about to develop itself, and in it the young buds are found to be lying behind and next to each other; the winter buds contain two buds of very unequal size, sometimes a third and fourth. The whole plant consists of parenchyma, has stomates on the upper surface, but the author could not find any nerves or vessels in the interior; he also saw no fructification. This is a valuable contribution to the knowledge of this misunderstood plant.

FERNS.

A DESCRIPTION of the germination of *Pilularia globulifera*, with relation to Bischoff's observations and corrections, will be found among the Botanic Aphorisms of Charles Müller, Flora, 1840, p. 545. After the capsule has been laying in the mud during the winter, it bursts in the spring in the shape of four valves, through which it discharges spores and sporules, which again produce new plants. The commencement of the germination he relates in the following manner:

—The hyaline globules of the albuminous substance develop themselves first in the interior of the spores; they swell, and, by so doing, the spores spring out from each other; through the opening thus made, a small hyaline vesicle first developes itself, which is soon followed by a second, and third, and fourth, all of which assume a crooked shape. The spores now burst into four lobes, and a green coloured material developes itself from the interior of them. The papillæ also now burst, and a green mass likewise issues from their openings. The author, in other respects, agrees with Bischoff. The fibres which Bischoff terms algoid or fungoid formations, the author considers as *Cotyledons*. In a supplement, p. 721, he is of opinion, that their office is to keep the spore above water, as it has become heavier by the pressing forward of the green matter. He likewise saw the bursting of the sporules, as he terms them.

How does the author know that the small globules are albuminous? Has he seen that they burst the spores by their swelling? Has he seen the bursting of the papillæ? His hasty determination, with regard to the albumen, induces me to put these questions.

On the *Structure of Isoetes lacustris*, by Hugo Mohl, Linnæa, vol. xiv. p. 181. The stem or root-stock has a double furrow, by which this species may be distinguished from the *Isoetes setacea*, Del., which has three such furrows, as Delile has observed. The root fibres are situated in these furrows, of which the upper grow upwards before the lower; not as is usually the case in this kind of root-stock, where the lower root fibres break forth before the upper. Another peculiarity of this plant consists in the fact, that the external layers of the stem wither away, and are supplied by new ones from the interior. The white matter of the root-stock contains parenchymatous cells; the small central woody matter has, above, an oval, below, a half moon, convex, round form; and consists of a uniform mass of small, short jointed, roundish, very loosely combined tubes, with large intercellular channels and spaces between them; the tubes are covered with irregular spiral fibres and ring fibres. The vascular bundles extend themselves from the woody substance, in all directions, and consist of tender, annular, and spiral vessels, and a few delicate oblong cells. The stem of *Isoetes*, like the other vascular *Cryptogamia*, has a vegetatio terminalis; the woody bundles do not form any layers with progressing age, but only lengthen at their upper end. With regard, however, to the parenchymatous part of the stem, the peculiarity is seen which we have mentioned before, namely,—that the whole parenchymatous substance is annually replaced by a new one, which developes itself in the circumference of the woody bundles, is forced towards the outside, withers, and at last decays altogether. The author says, in conclusion, " It must be regarded as very improbable, when the mode of germination of the other *Cryptogamia*, from which the germination of *Isoetes* certainly does not materially deviate, is considered, that these plants possess a real *Caudex descendens*. Since, however, the development of the root fibres takes place in a descending order, and since the central woody substance, from which the vessels of the fibres are derived, extend themselves downwards; we have, perhaps, in *Isoetes*, an instance before us of the case, which is so distinctly exhibited by *Tamus communis*, namely,—that the lower part of the rising axis developes itself, in relation to its growth, in the same manner as an original *Caudex descendens*, without being so in reality." It would have been desirable that the author should have examined *Isoetes setacea*, which is easier to be obtained than *Isoetes lacustris;* it grows after the root-stock has been dried for some time.

The remarkable phenomenon which M. Martens first observed at Löwen, in the botanical garden, that an intermediate species of fern grew where *Gymnogramma calomelanos* and *chrysophylla* were situated, has also been observed by Bernhardi in Erfurt (Ottos and Dietrichs Flora, 1840, p. 249 and 325). A fern has grown in the botanical garden of that place, which holds a middle rank between *Gymnogramma distans* and *chrysophylla*, species which are cultivated in the same garden, and had been frequently standing next to each other. The frond of this intermediate fern is doubly pinnate, decreasing towards the upper part; the shape of the pinnæ and pinnate divisions, holds a middle rank between the shape of these parts in its progenitors. The white powder of *G. distans* is scattered about at the base of the fronds and the pinnæ, where they are attached to the foot stalk, and the yellow powder of *G. chrysophylla*, but rather paler, is seen on other parts. M. Bernhardi considers these forms as real hybrids; he recommends particular attention to the fructification of the fern in these species of *Gymnogramma;* he thinks, that if his assertion respecting the male fructifying parts of these plants should be confirmed, the phenomenon may be more readily explained, than if other parts are regarded as anthers. M. B. rejects the opinion too hastily, that the species of ferns, of which such intermediate forms have been observed, may be modifications of the same species; indeed, these species are very similar, and the ferns are by no means so constant in their forms as the author thinks; on the contrary, they change very frequently, and much more so than other plants. It is often the case, that we see long and short, pointed and blunt pinnæ, on one and the same frond of the larger *Polypodiaceæ.* I have characterized two kinds of *Ceropteris* in the list of the ferns of the Royal Botanical Garden at Berlin (Filicum Species in Horto. R. Bot. Berolin. Cultæ. Berol. 1841), which have been considered as hybrids, *i. e.*, *C. Martensii*, alleged to be a hybrid of *C. calomelanos* and *C. chrysophylla*, and *C. Massoni*, a hybrid of *C. distans* and *C. chrysophylla*, which Bernhardi has mentioned. A *Ceropteris* is also described, which is an intermediate form between *C. calomelanos* and *C. distans.* The genus *Ceropteris* has its peculiar characteristics, not only in the singular hairs which secrete wax, but also in the distribution of the thecæ, which, like those of the *Gymnogramma*, are regularly placed in lines.

The author, in expressing his opinion respecting the anthers of the fern, says, they have generally been erroneously described, as the thickened ends of the leaf-nerves were mistaken for them, and this had probably been done for the sake of convenience, Sprengel's drawings having been followed without paying attention to his treatise. This certainly has not been the case; the treatise he alludes to was published forty years ago, in a journal which attracted more attention, and had a greater circulation, than was the case with Sprengel's drawings. But on following the particular and elaborate illustration of the author, I first observed the thickened ends of the nerves, and also, more externally, granules, which I took to be the author's anthers, but which appeared to me more like excretions. I have frequently sought in vain for definite forms, and it was certainly owing to this that I did not say any thing about it publicly, until at last the recollection of these granules vanished from my memory altogether, and I only recollected the impression of the very remarkable thickened ends of the nerves, which do not occur in any other class of plants. Sprengel has directed attention to similar points in the *Crassula crenata*, but these are very different from these thickened ends of the nerves, which consist of a bundle of spiroids, as they have been represented in the Icon. Sel. An. Bot. part iii. tab. 3, fig. 8. If any parts are to be regarded as anthers, they evidently are those which Blume first of all definitely indicated, and which are represented in the same part of the Icon. Sel. tab. 3, fig. 1–5; they certainly have the greatest analogy with anthers, although I by no means attribute to them the same functions which are possessed by the anthers of the phanerogamous plants. For we need only reflect upon the eye of the mole, which certainly cannot see with it, to be convinced that nature sometimes also arranges things for no particular purpose. But provided even that these anthers of the fern, or the parts acknowledged as such by Bernhardi, really possessed the function of impregnation, I yet cannot see how hybrids can be produced in this class of plants. With regard to the anthers of Blume, they are too near the pistils of the same species; and as to those of Bernhardi, the pistils in other species are situated at so remote a locality, that it is impossible to explain how the one could get to the other.

MOSSES.

On the Structure of the Setæ of Funaria hygrometrica, by Edwin Lankester; Annals of Natural History, vol. iv. p. 362. The fruit-stalks of this well known moss have already long been known to possess hygroscopical qualities. The author instituted a more particular examination with regard to them in this respect. On taking a dry fruit-stalk into one's hand, and moistening the lower part with the finger, the capsule will turn itself from the right to the left, by making two, three, or more turns; on moistening the upper part in the same manner, the capsule turns itself still more rapidly in an opposite direction. On a microscopical examination, the whole stalk was found to consist of lengthened cellular tissue, which is twisted in a spiral form. The cellular tissue is not, however, turned uniformly, but at two-thirds of the length of the stalk it commences to assume a straighter form, and at the upper part it again turns itself, but more acutely, in the opposite direction to that of the lower part. The cause of the turning depends on this direction of the cellular tissue. It may be left to discussion, whether the moisture renders the tissue straighter in consequence of extending it, or whether it originates from the mere distension of the external tissue. The capsule turns itself in an opposite direction to the spires of the wetted end, and the circumstance of its turning more rapidly on the upper end being wetted, depends on the more acute angle made by the upper spires. But the dryness of the fibres is not the sole cause, for the green fruit-stalks, although perfectly dried, do not turn when moistened. But as the capsule turns itself towards the earth at the period of ripening, it is probable, that the turning of the fibres already existing becomes stronger, and thus the movements are produced.

By the controversy which was at one time carried on between De Saussure and De Luc, it has been established, that dry vegetable fibre is shortened by moisture, but that the animal fibre is lengthened by it. Probably because the former is hollow, and is distended by the imbibed fluid, and thus shortened. The second, on the other hand, may consist of closely united dense parts, which the moisture separates from each other. In the case before us, it seems that the thick fluid contents of the cells leave a precipitate in the cells of the green stalks on being dried, and thus fills them up; but this precipitate is dissolved and absorbed, and otherwise applied on the ripening of the capsule, and thus the cells, being empty, act like hollow tubes on being dried.

LICHENES.

We find an account of H. Körber's paper, *On the Propagation of Lichens by means of Gemmules*, in the general sketch of the Works, &c., of the Silesian Society, &c., for the year 1840, p. 95. I only extract the following sentence, which appears to me to contain the principal matter of this treatise (p. 98):—"The individual propagation takes place through means of soredia, which form new individuals through an intercellular development. This intercellular development is prepared in the mother cell by the circumstance, that the primary gonidium, which at first is a distinct spherical cell, developing the organisable mucus contained in it into elementary globules. Further, the original mother cell is absorbed as soon as this is effected, and the soredium has issued from the thallus. The soredium is, therefore, nothing more than the contents of the mother cell, which have become free, and which develop a connected cellular tissue, from those new cells (globules) which are combined together by means of the formative mucus. These new cells, therefore, seem to be a kind of cytoblast from the original now absorbed mother cells, which, however, are still capable of transforming themselves."

On examining *Lobaria pulmonaria*, which certainly exhibits large soredia, it will be seen, that at least with regard to them, there is not a word of truth in all that the author has stated. Such a soredium is represented in the third volume of the Icon. Sel. Anat. Bot. (1841), tab. 5, fig. 11. It will be seen, that the internal flocculent matter, which in *b*, fig. 13, has been represented very much enlarged, breaks forth and forms the soredium. The external cellular integument, which is seen very much enlarged in fig. 13, on the other hand, is broken through, and nothing of it goes to the soredium. I doubt very much if the individual propagation of *Lichenes* takes place by soredia.

ALGÆ.

Remarks on Spongilla fluviatilis, by John Hogg, in Transactions of the Linnæan Society of London, vol. xviii. part iii. (1840), p. 363 and 368. The author, in his first essay, declares himself in favour of the vegetable nature of this organization. He says, that he cannot believe that the seed-like bodies of the *Spongilla* are the eggs of a *Cristatella* (*vagans*), since he has never found such a *Cristatella* in their vicinity. In the second essay he relates, circumstantially, his observations on the *Spongilla*. In the year 1838, he observed some germ-like bodies, which floated about in the vessel in which were a number of vegetating *Spongillæ*. They were small, but visible to the naked eye, of a globular, or rather of an oval shape; the lower and smaller part is opaque, the upper transparent and membranous. Their movements were as remarkable as they were elegant; they rose from the *Spongilla* at the bottom of the vessel to the surface, and either floated slowly on the surface, or roamed through the water like a balloon in the air. They approached or removed themselves from each other; calmly suspended themselves in a given spot, or turned round in circles. They always, however, moved in such a manner, that the round part was before. He placed one of these bodies in a watch-glass, and renewed the water daily twice or thrice. At first, the body moved itself, then it turned slowly round on its axis; finally, it established itself firmly, and became converted into a white opaque substance, which, as it grew in the water, appeared to be gelatinous, but when dry, exhibited small cells, and fibres, and points. About the same time, he made an experiment with the seed-like bodies which he terms sporules. He took them off from the *Spongilla*, and placed them in a cup, which he filled with water, renewing it twice a-day. These bodies did not move, but (after they had lain for some time) a white opaque substance issued from the opening at their point, which glued the seed to the cup. This substance gradually increased, and overspread sometimes the mother body entirely, spreading itself, likewise, round about over all substances situated near it. At first, no traces of the *Spongilla* itself were seen, but only a white, thick, gelatinous matter; but, on suffering this latter to become dry, a membrane of the sponge exhibited itself, and the holes could be seen which were formed by the interlacing of the fibres, as also the small points. The author now investigated, whether the germ-like bodies had converted themselves into the seed-like, and decided against it; he thinks they are different reproductive organs, which he terms sporules and sporidia. He further enumerates observations respecting the movement of the germ-like bodies of other *Algæ*, especially of *Ectosperma clavata*, as a confirmation of the plant-like nature of the *Spongilla*. He saw the currents about the germ-like substances of the *Spongilla*, when they moved, but he did not observe cilia, as are found in real zoophytes; he even considers these cilia as characteristic of animal beings. The movement of the germ-like bodies of the *Algæ* he believes to originate in an endosmosis and exosmosis. He then enumerates other correspondences between the *Spongilla* and vegetables, as the similarity of the membrane, the gelatinous substance, the green chromule (chlorophyll), its behaviour in acids, and its development of gas in the light. He further speaks of the currents which flow from and into the cavities of the *Spongilla*, and attributes them, for the most part, to an animalcule of a green colour; not entirely, but in some measure also, to endosmose and exosmose. The author then endeavours to refute Dujardin's reasons for supposing the *Spongilla* to be of an animal nature; and lastly, adds some remarks in favour of the vegetable nature of the Sea Sponges.

The observations of the author deserve great attention. Many reasons given by him, in favour of the vegetable nature of the *Spongilla* and the Sponges in general, might certainly not be found sufficient; but we must agree with him in the principal matter, for this reason, that these substances are deficient in a central organ, the stomach, which is peculiar to all animals. The *Spongilla* is not secreted from an animal substance, as the stems of the *Sertularia*, and similar zoophytes, which I acknowledge now to belong to the animal world, although I formerly believed they were plants. It is not, however, at all credible, that a variety of movements, such as the author observed in the germ-like bodies of the *Spongilla*, should originate from endosmose and exosmose; the membranes by which endosmose and exosmose take place remain immoveable, for the very reason, that the current of the fluids goes through them. Endosmose and exosmose can only be employed as an analogy for the explanation, and not as an explanation itself, for the simple reason, that they have not yet themselves been explained.

Several observations have been published by Laurent on the same subject, *i. e.*, on the *Spongillæ and their Propagation*, in the Comptes Rendus of 1840, vol. ii. p. 478, 694, 1050. M. Laurent assumes the animal nature of this organization. They exhibit, according to him, a three-fold mode of propagation:—1st, Germ-like bodies, which he considers as unciliated (non ciliés) buds: 2d, Egg-shaped bodies, which are formed in the spring, and are different from the egg-formed bodies of the later season: 3d, Protean bodies, which liberate themselves from the rhizopodal prolongations of the young *Spongillæ*. He also speaks of propagation by self-division (scissiparité naturelle) of the old *Spongillæ*. M. Laurent, in the second memoir, goes through the various phases of life of these *Spongillæ*. The first phase is that of latent life, in which the egg-shaped bodies and gems are first found; the contents of the former are then globular-watery (globulino-aqueux), and at the period of the latent life of the latter, the whole *Spongilla* is still in this state (globulino-aqueux). The small projections are still wanting at this time. The second phase is that of the embryonic state, when the whole tissue is almost subglobular-glutinous (subglobulo-glutineux); the eggs are transformed from the globular-watery state into the globularglutinous state; the gems also of the unciliated embryos, formerly globular, now become oblong; the projections and protean bodies appear first. The *Spongillæ* which are formed in this threefold method are the same. The *Spongillæ* in the third state appear to be first covered with a membrane, and, upon its bursting, the cavities and the eggs are seen. The propagation through protean pieces only takes place in very young individuals, which are produced from non-ciliated embryos, as the self-division (scissiparité naturelle) only takes place in old individuals, which have been produced from the same embryos. In the third memoir, he compares the non-ciliated free embryos of the *Spongilla*, with the free embryos of *Ectosperma clavata*. The former move about from two to three days, whilst the latter only move from two to three hours, or even immediately establish themselves. Upon applying a magnifying power of 2–300. i. d., the fibres of the embryos of the *Spongilla* were distinctly seen, but not in those of *Ectosperma;* the former also have a current around them, but the latter have not. The embryos of the *Spongilla* are white, those of the *Ectosperma* are green.

I may here refer to some observations of Agardh, in Suensk. Vetensk. Hdlgr. f. År, 1837, translated in the Flora for 1840, p. 128, where he states, that a *Draparnaldia tenuis* developed itself from moving granules; also, that he observed a movement of the granules in the articulations of the *Bryopsis arbuscula*. M. Morren's observation, that he found the *Rotifer vulgaris* in *Vaucheria clavata* (*Ectosperma cl.*), in such a position that it could not be removed on the opening of the articulation, is worth attention. Bullet. d. l'Acad. Roy. d. Bruxell., vol. vi. p. 4.

The current of fluid, observed by M. v. Lobaczewski, in the *Closterium lunula*, Nizsch, described in the Linnæa, vol. xiv. I must leave to the Zoologists, although the phenomenon is very similar to those which have been observed in *Chara* and other plants.

The observations too, which Meyen has made with regard to red snow, in Wiegmann's Archiv, 1840, vol. i. p. 166, belong to Zoology, in as much as *Protococcus nivalis* and *viridis* are

Infusoriæ, and *Euglena sanguinea* and *E. viridis*, Ehrenb., are at present doubtful beings.

FUNGI.

Dry Rot, by Schwabe, Linnæa, 1840, p. 194.—The author describes the dry rot, *Boletus destructor*, Shrad. (*Polyporous destructor*, Fries), especially the thallus, very accurately, from its first origin, and mentions, that it is more frequent in Dessau than *Merulius vastator*, Tode (*lacrymans*, Fr.) The destruction of the wood, he adds, seems to be caused by the fibres of the fungus depriving the woody cells of their contents, for the purpose of obtaining the nourishment which they require for their vegetation, by which the latter loose their consistency and toughness; the membranous walls of the cells suffer particularly, for they are always seen brittle and torn, on examining them under the microscope. In Berlin, which certainly is not far from Dessau, the *Merulius vastator*, Tode, is the most frequent. The latter, however, rather imbibes the humidity of the atmosphere by its fibres or tubes, which is distributed through the wood, and thus produces decay or decomposition.

Penicillum Bioti, described by Turpin, Comp. Rend. vol. i. p. 507. This mould had grown in a closely corked bottle, in which there was distilled water, with some dextrine, which Biot sent to the author. He describes the thallus of this fungus with great exactness, and adds, that its swollen articulations contain granules, which have induced him to classify it as a particular species. Of the fructification he says, When the vegetation has come to a certain point it decreases, the articulations of the small stems become shorter, more globular, and arrange themselves in a moniliform row, which is either simple or compound. The small globules are of a bluish colour. The fungus, according to the author, propogates itself in a threefold manner; 1st, By an almost spontaneous generation, for the organized globules of the dextrine need only to be properly arranged, in order to represent this mould at once: 2d, By globules in the tubes; and, finally, by separated joints.

I doubt if *Penicillum Bioti* be different from *Penicillum glaucum*. The latter is produced in all mucus, sweet, and vegetable acid solutions, also in solutions of salts which consist of vegetable acids.

Gardner has discovered a *new phosphorescent fungus* in the Brazils. Description of a New Phosphorescent Species of *Agaricus*, by George Gardner; with Remarks upon it by the Rev. M. J. Berkeley. Hooker's Journal of Botany, vol. ii. (1840), p. 406. It belongs to the tribes of pileo-eccentrica, and Berkeley states, that it might be classified in the subgenus *Panus* of Fries. The characters of it are, Pileo carnoso-coriaceo, subindfundibiliformi, glabro, flavo, lamellis longe decurrentibus pallidioribus, stipite brevi, coriaceo, glabro, cinerascente. Hab. in Brasilia, ad folia Palmarum, quae ab incolis dicuntur *Pindoba*. During a dark night, at the commencement of the month of December, in the town da Natividade, in the province Goyazes, Gardner witnessed some boys knocking about a shining fungus with sticks; this induced him to get the perfect fungus, in which he succeeded, and thus was enabled to give a description of it. Berkeley adds, that there are several species of fungus which emit light in the dark, and mentions the *Ag. olearius*, Dec.; he also proposes to change the name of *Ag. phosphorescens* into *A. Gardneri*. It is a question whether these species of fungus are always shining. The *Rhizomorphæ* do not shine under all circumstances.

Chrysomyxa abietis, a fungus and eruption (exanthem) of the red fir, is described by F. Unger. See Froriep's Neue Notiz. xvi. (1840), p. 10. The following is an abstract of Unger's remarks on its comparative pathology; Vienna, 1840. He first gives an exact anatomical description of the leaves of the fir, and then proceeds to the description of the exanthem. It is found on the last annual shoot, and on almost every leaf. There are yellowish discolourations on the upper side of the leaf, and similar discolourations on the under side; also one or several rust yellow spots, but only where there are rows of stomates. The yellow rust spots are elevated into a wart-like substance, and the upper membrane is torn open ; dense tubes, of a deep red colour, are seen at the edge, and irregular tubes towards the middle, which are rather enlarged towards the upper part, and partially entwined with each other, and are seated on a mucus granular material. This substance constitutes the stroma of the pustule. A tissue of cylindrical, simple and ramified, very much matted together, fibres, is next produced. The disease terminates with the falling off of the leaves. It originates in the air holes of the leaf, in the form of a mucus granular material. The author attributes the cause to the moisture, which impedes the process of respiration. He concludes by saying, That the disease is a heterogeneous generation.

The air holes (or organs of respiration) of the author are a layer of large cells. The author confesses, that the stomates are closed up even in the youngest leaves ; but is of opinion, that the air can penetrate nevertheless. We quite agree with the author in his concluding sentence, but this is a subject of general physiology and pathology.

M. Lucas has found humin in the *Uredo segetum* ; Einhof found the same substance, but did not recognize it as humin. Braconnot separated humin from the spiroids of *Agaricus atramentarius*, Bull ; and this substance, indeed, seems to prevail in many of these lower plants. Annal. d. Pharmacie v. Wöhler and Liebig, vol. xxxvii. p. 90.

MONSTROSITIES.

M. DE LAFONT, Baron von Melicoeq, describes several modifications of the *Linaria vulgaris*, in the Annal. d. Scienc. Natur. S. II., vol. xiv. p. 255, which may be compared with the great collection of such modifications which M. Pr. Ratzeburg has published. They were collected at Cambrai and Arras, and are,—1. Corolla with two lips, two spurs, equal or unequal ; one of the flowers had six filaments, of which two were shorter than the others. 2. Corolla with two lips, three spurs, the central one longer ; of pretty frequent occurrence. 3. Corolla with two lobes, three long equal spurs ; of rare occurrence. 4. Corolla without an upper lip, the lower lip with four divisions, four spurs of the same length, four sepals; a solitary specimen. 5. Corolla almost without an upper lip, the lower lip with five divisions, seven spurs, six filaments, two shorter, eight sepals; very rare. 6. Regular corolla, with five divisions, five spurs; rare. 7. Corolla with two lobes, but at the base with one to three, even sometimes four, flower-like appendages, coloured like the lower lip of the corolla; some of these corollas had two spurs; one specimen had a very developed corolla-like appendage, almost as long as the corolla; the two lips of the latter were lying horizontally, the spur had remained vertical. 8. Corolla perfectly reversed, and provided at the base with a genuine petal. 9. Corolla with two lobes, a flower-like appendage at the basis, three spurs of the same length, fibre filaments; rare. 10. The upper lip of the corolla with three divisions, the lower lip in four; rare. 11. Corolla with two lobes, without spurs. 12. Stem with bands. It is owing, in my opinion, to the singular position of this species, between the *Personatæ* and the *Solanaceæ*, that the flower of *Linaria vulgaris* exhibits a greater number of modifications than any other plant. It is, to make use of a simile, as if the flower was resorting to all possible means to return from its fettered state with the lips of the *Personatæ*, to the regular one of the *Solanaceæ*, with which it is really related. The modifications do not, as far as I know, extend themselves to the ovary, for it has nearly the same form in both these natural orders.

M. Göppert has published an account of some observations on *Malformations* in a specimen of *Tragopogon orientale*, in the general review of the works of the Silesian Society, f. v. L., 1840, p. 103. The pappus, in most of the flowers, was changed into small lancet-like pointed leaves, and the corolla, anthers, and stigma, were coloured a slight green. In some flowers, the filaments, as well as the anthers, were changed into small tender green leaves, and a new, perfect, small flower-head had formed itself in the axil of the stigma; the stigmata, at the same time, commencing to assume a leaf-like character. A rare proliferation certainly.

M. Naudin, in the Ann. d. Scienc. Nat. vol. xiv. (1840), p. 14, describes some *small plants of Drosera intermedia, produced on the leaf of another.* A leaf of *Drosera intermedia* (*Dr. anglica*), exhibited two small plants of *Drosera* in miniature on the upper side of its edge, which were developed from the cellular tissue, between the mid rib and lateral leaf-nerves at the edge, and stood at about the distance of a line and a half from each other. They were from five to six lines in length, and had, singularly enough, a stem with alternate leaves (according to the illustration); the native species of *Drosera* being stemless, and only provided with root leaves, which, in this instance, was the case with the mother plant. Nothing could be observed at the lower side of the mother leaf, excepting a black spot beneath one of the two stems, but no roots. The stems, however, issued from the naked cellular tissue, and stood in no connection with the vessels of the leaf. A very singular and remarkable monstrosity.

M. Walpers makes mention of a *Monstrous Seven-leaved Leaf of Trifolium repens*, in the Linnæa, vol. xiv. p. 362, and considers the three-leaved, as well as the simple leaves of the genus, as shortened pinnated ones. He adds, that the leaves of *Gleditschia triacanthos*, in which almost all the forms of leaves which occur in the *Leguminosæ* may be easily observed, together with their transformation from one into the other, are particularly instructive.

M. Hampe observed, in a bush of *Salix repens*, that twigs above the water blossomed as females, whilst those twigs, which had been in the water, and subsequently blossomed when the water was dried up, had only male blossoms. He endeavours to prove, by other instances, that *Diclinous* plants, situated in wet localities, produce more male than female blossoms. See Linnæa, vol. xiv. p. 367. The editors, in a supplement, add many observations respecting the change of sex in willow trees, without, however, determining the causes.

Remarks on the Ergot (*clavus*), by John Smith, Linnæan Transactions, vol. xviii. p. 3 (1840), 449. He analyzed the mucus sweet liquid of the ergot in *Elymus*, and found in it oblong transparent bodies, similar to the sporidia of a fungus. He found the same body also in all states of the ergot, as far as the anthers of the affected ears, both in *Elymus* and in *Phalaris aquatica;* he therefore regards it as the cause of the ergot. The sporidia, according to Mr. Smith, first get into the earth, thence through the stem, as far as into the anthers, and finally through them into the ovary. He adds, also, that these sporidia have been observed by several individuals. Mr. Quekett next gives a very elaborate circumstantial treatise on this subject. The oblong bodies, sporidia, lie in ramified fibres upon the ergotised grain when it is young, but are no longer found when it is perfectly grown. The author observed the external pericarpium in torn pieces on the surface. In the interior, he found an irregular cellular tissue; he did not find the cells of the external membrane to be oblong, as phœbus, but small and quadrangular. The appendages at the point, according to the author, consist, for the greater part, of the torn pericarpium, which could not follow the growth of the grain, and thus was elevated to the point. He then gives an accurate description of the fungus, which spreads itself over the grain; he witnessed the multiplication of the sporidia, when placed in a wetted glass, either by a tube shooting forth from one side, with partitions, the joints of which separate themselves as sporidia, or by a small bud being produced at the end, which grows into a sporidium. Another kind of multiplication takes place, when the epidermis about the sporidium is torn into pieces, and sprouts out, developing granules upon itself, which become similar to those in the interior—the sporidia. The last kind of growth is the following:—A green granule extends itself laterally in the sporidia, and forms a partition, and thus divides the sporidia into two parts; each part again divides itself, and so on, so that thus a jointed simple fibre is produced, which then becomes further ramified. He also saw small green granules collected on the glass, which had separated themselves from the sporidia that were torn, as might be inferred from the presence of the torn sporidia, and which developed themselves into sporidia. As this fungus, therefore, can vegetate on glass, remote from the grain, it would be a reason for the conjecture, that the fungus is quite different from the ergot. The author found no sporidia in the interior of the ergotised grain; the nuclei which were in it are lighter than water, whilst, on the other hand, the sporidia sink in water; the nuclei melt when exposed to heat, and then flow one into another, the sporidia do not; the former also may be dissolved by ether, not so the sporidia. The author lastly resorts to a chemical analysis, to prove that the ergot is no fungus. The author is of opinion, that the green granules of the fungus penetrate into the interior of the grasses, and develop themselves upon the ovary as upon a proper basis; they communicate the disease when they get into a sound grain, by destroying the membranous pericarpium. He terms the fungus *Ergotætia abortifaciens*, and describes its characteristics as follows:—"Sporidia elliptical, moniliform, finally separating, transparent, and containing seldom more than one, two, or three, well defined (greenish) granules." He finally adds, that a small *Acarus* (of which he also gives a rough illustration) destroys the ergot, which is important for the science of pharmacy. A brief treatise on this subject, by Francis Bauer, then follows. He rejects all external causes for the ergot, and terms it a monstrosity. He gives some excellent illustrations, in order to prove that it is the scutellum which increases in size, tears the skin of the pericarpium, and is then coloured brown. Since the fungus also occurs on other parts of the grass besides the ovary, he is induced to think, that the latter does not produce the ergot, but that it only occurs incidentally.

The now deceased excellent artist was certainly right. Quekett's researches and reasons afford more proof *against* the origin of the ergot, from a fungus, than in favour of it. And, supposing even that the fungus only did occur in the ergotised grain, and did not grow at all without it, this would yet be no sufficient reason for the assertion that it was the cause of the ergot. Is *Tubercularia vulgaris* the cause of the dryness of wood, because it is not found upon any thing else than dry wood, or only the consequence? I laid drawings of the ergot before the assembly of Naturalists, at Florence (1841), in which the grains at the point had sprouted out into three leaves; an additional reason in favour of the ergot being only a monstrosity. It still remains to be ascertained, whether the excresence only occurs on the scutellum. The fungus which Quekett has very well described, is an *Oidium.* It is well that we can get rid of such an abominable term as *Ergotætia*, badly formed as it is from the Greek and the French. The observations on the different modes of propagation are very interesting; it is a question, however, whether they are not the result of an optical illusion.

SECRETION.

Observations on the Phenomena of Water Drops on the Leaves of some Plants, by Rainer Graf, Flora, 1840, p. 433. The author principally instituted his observations on the *Impatiens nolitangere.* These drops may be observed in the cotyledons, and that always at the small teeth, in which the nerves of the leaf terminate, which run through the centre of the leaf. Small drops even make their appearance in the primordial leaves, whilst they are still folded together in the bud, they occur at the edge in all places, which subsequently become crenated. As soon as the leaves of the plant have attained their full development, the drops appear on the crenatures, which have been formed by the tendril, and by the secondary nerves in the leaves. The still undeveloped leaves of all succeeding buds, are also covered with drops in the same way as the primordial leaves. A small drop appeared regularly at the point of each of the calyx leaves, until the capsule began to swell, also on the point of the bracteæ, and, finally, also on the flowers. They appear here at the middle tooth of the upper arched petal, and at the point of the lower valve-like calcareate petal. The drops are largest on the cotyledons, those on the leaves follow next; and there they are always larger at the points of the tendrils than at the points of the secondary nerves. The drops, which in other respects consist of perfectly tasteless and scentless water, usually appear within ten or twenty minutes after rain or watering the plant. If the plants had become withered before watering, the upper leaves first erect themselves, the branches follow next, and thus it goes on to the lower leaves. The capsules also, when quite at rest, are in the habit of opening as soon as the drops appear after the water. The drops likewise disappear again, and that in a very different manner. Sometimes they are suspended without any change for the whole of the day, at other times they disappear again in half an hour. The author could not attribute this to mere evaporation, and made the following experiments:—He managed to attach a drop of common water, of about the size of the drops in question, by means of a fine needle, to the edge of the leaf, at a place where there was no aperture to the nerves. This drop was to be perceived for a considerable time after, the other drops which had made their appearance at the apertures of the nerves, had all disappeared. The author, in order to proceed with still greater security, took off a drop, that had made its appearance, with great caution from the crenature, and attached it to another part of the leaf; this also was to be seen unchanged after a long time, whilst the other drops attached to the crenatures had disappeared. The appearance of the drops, therefore, on the plants, the author adds, cannot always be considered as a secretion of the superfluous nourishing sap; but it seems, on the contrary, that the sap rises so rapidly, and in such great quantity, that the same cannot be immediately and properly distributed, and consequently issues at all apertures. As soon, however, as the distribution of it has taken place in the cellular tissue, the part temporarily secreted, in the shape of drops, is also imbibed, and applied to further distribution in, and nourishment of the plant. The author instituted similar experiments with the leaves of the cauliflower, and the result was the same; he also observed the same occurence sometimes when the drops had accidentally got displaced. Although the drops of the cauliflower are larger than those of the *Impatiens nolitangere*, they yet disappear more rapidly, very probably owing to the greater circumference of the leaves, in which the distribution takes place more rapidly than in the smaller leaves.

This familiar phenomenon has found, in this instance, an excellent observer. That the vessels, the spiroids, namely, which are situated in the leaf-nerves, carry the juice of nutrition rapidly from one place to another, conducting it finally to those points where it is necessary for the nourishment of the plant, is convincingly demonstrated in these observations.

Remarks on the Formation of Crystals in the Vegetable World, have been published by Unger in the Ann. of the Vienna Museum of Natural History, vol. ii. p. 1. After having treated generally of their occurrence, he gives drawings of crystals in the cellular tissue of many plants, which, however, are not sufficient for their determination, as the sizes of the angles are not stated. This is followed by some chemical researches. He dissolved crystals of *Piper blandum*, *Ficus bengalensis*, and *Maranta zebrina*, in nitric acid, and neutralised the liquid with ammonia. The precipitate was heated in a platina crucible; that of the crystals from *Piper blandum* was alone coloured brown. After having been heated, effervescence of all of them took place, on being treated with acids. The crystals consisted, in all three cases, of a vegetable acid, and most probably of lime; the acid in the crystals of *Maranta zebrina* and *Ficus bengalensis* were oxalic acid; the acid, however, in the crystals of *Piper blandum* must have been a different one.

Payen has instituted some researches on the *Calcareous Precipitates, and Precipitates in General in Plants.* (Compt. Rend., 1840, vol. ii. p. 401). The stalked, club-shaped substances in the species of *Ficus*, which are covered with calcareous precipitates, and which Meyen first observed, have been investigated by the author in *Ficus ferruginea, laurifolia, bengalensis, nymphæifolia, elastica, Carica, religiosa*, and *reclinata;* further in *Parietaria officinalis*, where they are very large; in *P. lusitanica* and *arborea*, *Urtica nivea*, and *Forskalea tenacissima.* The cylindrical concretions from *Celtis australis*, and the pear-shaped ones from *C. missisipensis* were similar;

likewise the concretions in the leaves of *Morus nigra, alba*, and *multicaulis;* those of *Broussonetia papyrifera, Humulus Lupulus*, and *Cannabis sativa*, are situated at the basis of the hair. These substances are generally found on the upper surface of the leaf, beneath the epidermis, at times on the lower surface, as, for instance, in the ordinary fig tree, more rarely on both sides at the edge, as in hemp. A large leaf of *Broussonetia papyrifera*, contained 134,000 concretions. Carbonate of lime is frequently met with between the cells of the parenchyma of the leaves and their nerves, in the channels of the petioles of the leaves, and of the stems; it is also found under two forms in the leaves, one containing a juice so acid, that it would dissolve the carbonate of lime. The author is of opinion, that the deposit here takes place through the carbonate of ammonia of the atmosphere. The oxalate of lime forms glands in the leaves and the stems of *Cactus*. Raphides consist of a membrane, which is filled with oxalate of lime; they develop themselves in cells, which consist of a special tissue, and contain a nitrogenous substance. Silica covers the membranes of the leaves of many plants, perhaps of all; and is found also in the cells of the stems of the *Gramineæ, Characeæ*, and *Equisetaceæ;* also in the intercellular spaces, and likewise in the form of a spheroidal concretion, which is secreted by a tissue that developes itself in a cell. *Chara translucens* is incrusted with silica; *Chara vulgaris*, in the same water, is found covered with carbonate of lime and silica, whilst *Chara hispida* has only carbonate of lime.

SPERMATOZOA IN PLANTS.

On *the Anthers of Chara, and on the Animalcules in the same*, by Gustav Thuret, Annal. d. Sc. Naturell. vol. xiv. p. 65. The so-called anthers of *Chara*, consist in their interior of a convolution of fibres, with partitions, in which the spermatozoa are situated. These fibres, in the young state, are only oval sacs, they then get partitions, and afterwards, frequently very rapidly, a nucleus is produced, which assumes a brown colour on the application of tincture of iodine. The animalcules appear subsequently to the nucleus, and remnants of the nucleus may sometimes be seen on one side of the cell, and on the other side an animalcule. These animalcules are at first immovable ; they soon, however, make efforts to liberate themselves from their prison. They move themselves more rapidly in the warm than in cold weather, and in such a manner, that their animal nature cannot be doubted. The most distinct part of the body is a spirally formed twisted fibre, with three to five twinings. Two bristles or feelers (tentacules) appear just behind one of the ends of the spines ; they possess extraordinary sensibility, and with them the animalcule moves continually with great rapidity. They are, therefore, not seen as long as the animalcule is alive, but only when its movements become slower, or cease altogether. They are seen best when some tincture of iodine is put into the water, when their movements cease, and they become more visible by the brown colouring. This is particularly the case, if the water with the tincture is allowed to evaporate from the vessel which contains the object. The author also observed a current of fluid in the sacs which surround the fibres.

Meyen has published an accurate description of the anthers of the *Characeæ*, and of these animalcules, in the third volume of his Physiology. He did not see the two feelers. I was, he says, p. 223, at first only able to recognise the existence of the long thin end, through the few thicker little points. Two, and even three, small points of the kind are frequently seen, which change their position with great rapidity. He adds, “ For some time I was of opinion, that the fine end of these spermatozoa was ramified, and that the little points were to be considered as the thickened end of these branches ; but in the spermatozoa, which seemed to die slowly, from their movements gradually becoming more slow, I was at last able distinctly to observe, that the fibrous end in the spermatozoa is as little ramified as in those of the lower plants.” Who, then, is in the right ?

GROWTH—NUTRITION.

Chemical researches can only be taken into consideration here, in as far as they have reference to the plant as an individual. They belong to a division of chemistry, called organic, which only contemplates substances produced by a vital process.

An important work has lately been published, in relation to the nutrition of plants: *Organic Chemistry, in its Application to Agriculture and Physiology*, by Justus Liebig. Brunswick, 1840. The contents of this work are well known to all who are occupied with subjects of this kind, and it will not be necessary to give extracts from it. I shall, therefore, only take the liberty of making a few remarks. It proves, in a very convincing manner, that the substances which are taken up from the humus, by water, are not sufficient to yield the carbon which is found in plants. It would, on the other hand, have been desirable, if it had been proved equally satisfactorily, that the atmospheric air, which surrounds the plants, both in the quantity of carbonic acid contained in it, and decomposed by the plant, was sufficient to afford the plant the carbon which it requires for its sustenance. The author's remarks on this point are very arbitrary. He calculates the weight of the whole atmosphere, the thousandth part of the weight of which, according to the experiments of Saussure, is carbonic acid; and thus gives a number of pounds for the carbonic acid contents, which far exceeds the quantity of carbon in plants. He further assumes, that the surface of the leaves of plants, is twice as great as that of the surface of the soil upon which they grow; and that in each second of time, during eight hours daily, 1-1000th part of its weight of carbonic acid is extracted from the atmosphere; so that the leaves, in 200 days, take up 1000 pounds of carbon. The last assertion is entirely hypothetical. The first calculation is founded upon the circumstance, that carbonic acid is equally diffused through the whole atmosphere; a fact, however, which is by no means perfectly established. Experiments in Ward's apparatus would be far more convincing. The author further treats of imbibition of oxygen by plants, first observed by Saussure, and says, This process has no share whatever in the life of the plant. Oxygen is, however, consumed in plants. The scentless and tasteless leaves of *Agave americana*, take up little; those of *Pinus abies*, containing oil, more; those of *Quercus robor*, containing tannic acid, still more; among all of them, the balsamic (? ?) leaves of *Populus alba* most. The author adds, that beyond a doubt, and most manifestly, this chemical action exhibits itself in the leaves of the *Cotyledon calycina*, and of the *Cacalia ficoides*, and others. In the morning they are acid like sorrel (there is proof of this wanted); towards noon they are tasteless; in the evening bitter (not to be perceived). A genuine process of oxydation, he says, also takes place at night; the acid formed, enters into substances which contain hydrogen and oxygen, in the same proportion as in water, or that contain less oxygen, as in all tasteless and bitter matters. But, on causing *Cotyledon calycina* to remain the whole day in the dark, the reaction of the juice is always acid; and the most simple inference is, that the oxygen, which, when taken up, constitutes the acidity, is again secreted when exposed to the light. The author likewise asserts, that the exhalation of carbonic acid which has been observed, has nothing to do with the process of assimilation. The water of the soil contains carbonic acid gas, which is taken up by the roots and by the leaves, with the water, and is again exhaled. But why is this carbonic acid not decomposed, and would it not be a much better source of sustenance than the atmosphere itself? Is the whole of the carbonic acid of the atmosphere really decomposed?

I by no means wish to dispute the principal fact, but would suggest, that the dictatorial manner assumed by the author, must render his conclusions suspicious. The author is quite angry, that the talent and ability of Botanists should have been wasted in the investigation of the structure and the external forms of plants, whilst chemistry and physiology have been neglected, in the explanation of the most simple processes. As a proof, he quotes Reum's Forest Botany, and a sentence from Burdach's Physiology. Why these, above all? It certainly is unjust to attribute to all the neglect of two. Chemistry has certainly been taken into consideration in the better systems of physiology; but Botanists cannot be blamed, if they do not at once take every thing for granted that is told them by chemists. The author further says, in his indignation,—As soon as the mysterious vital power is presented to the physiologists in some phenomenon, they renounce their senses and judgment, &c., &c. Strange! Finally, the author demands, that the bugbear, "vital power," as he expresses it, be assumed, to place substances together in such a manner, as to constitute a spiral vessel, a cell, a leaf, a blossom. The author then proceeds to the assimilation of hydrogen in plants. He says, the solid part of the plant, the woody fibre, contains carbon and the constituents of water, or the elements of carbonic acid. We can suppose the wood to be produced from the carbon of the carbonic acid, which is combined with the elements of the existing water, under the influence of the light of the sun; in this case, oxygen is given off as gas, and the carbon is assimilated in the plant; or, what is more probable, the plant, under the same circumstances, containing carbonic acid, decomposes the water; its hydrogen is assimilated with the carbonic acid, in order to form the woody fibre, whilst its oxygen is given off. The woody fibre contains carbon and the constituents of water; there is, however, more hydrogen in the wood than corresponds with this relation; hydrogen is situated within the wood, in the form of chromule, wax, oil, resin, &c., &c. It cannot be doubted, that hydrogen is assimilated by the plant from the water; but it has not yet been explained how this is done; the author only states conjectures, and does not enter into the reasons of the chemical combinations and decompositions. The assimilation of nitrogen, according to the author, takes place from the carbonate of ammonia in the atmosphere, which is carried down by the rain, and imbibed by the roots of the plant. Rain water, according to the author, contains carbonate of ammonia. This salt gets into the atmosphere through the medium of decaying animal and vegetable substances. This seems to be very correct. Gypsum, the author adds, is used as manure, because it decomposes carbonate of ammonia, and fixes it as sulphate of ammonia; it does not act as a stimulant; a plant has no nerves, therefore there can be no substances by which a leaf can be stimulated to appropriate to itself a greater quantity of carbon from the air, when the other constituents are wanting which the plant requires for its development. The explanation of the mode of action of gypsum is improbable, and the author must show, first, that sulphate of ammonia has been formed in gypsum, when long exposed to the atmosphere, and why plants should not be capable of stimulation. A considerable part of the work of the author is devoted to the inorganic constituents of plants. He shows their constancy, and also, that one constituent supplies the place of another in its various combinations; thus, for instance, it has been proved, by the analyses of the fir of different localities, that the number of bases is certainly different, but that the quantity of oxygen in them is the same. Indeed, it is very probable, judging from what the author states, that alkaline bases are essentially necessary for the development of plants. These constituents of the soil, in general, have the greatest influence upon the growth of plants, a circumstance which is elaborately investigated in the sections on the culture of plants, on the rotation of crops, and on manures. This first part appears to me the most important in the work, as belonging to our subject; the second part is purely chemical.

In the Journal of Practical Chemistry, by Erdmann and Marchand, vol. xx. p. 267, we find a continuation of confirmatory experiments, *on the effect of humic acid* bases *particularly of those prepared from peat as a means of manure*, by W. A. Lampadius. The composition consisted of the refuse of peat, of chalk-dust, of brick-dust, and ashes, in the proportions 53, 3, 3, 3. A development of carbonic acid is probably also effected here, through the action of humic acid on the chalk-dust.

Speculations on the *sources of Carbon and Nitrogen in Plants and Animals*, are found in Daubeny's Lectures on Agriculture, and an extract from them appears in the Edinburgh New Philosophical Journal, vol. xxx. p. 360. Daubeny directs attention to the fact, that carbonic acid and ammonia, which, as he had proved to be the sources of the carbon and of the nitrogen in plants, were contained in so varying proportions in the atmosphere, that they would appear to be opposed to combination; and also, that they were known to issue from the interior of the earth at different places. The author adopts Liebig's theories; his argument is generally physicotheological, and he cites the fact, that ammonia would be injurious to plants if given alone in a requisite quantity. This might be easily answered. But the presence of carbonic acid in all spring water, would certainly seem to favour the conjecture of a subterraneous origin; and the phenomenon of ammonia in rain water, might likewise originate from a general telluric cause, even if we do not exactly take into consideration volcanic agency. But this subject, properly speaking, belongs to geology.

MISCELLANEOUS.

Etudes sur l'Anatomie et la Physiologie des Vegeteaux par Th. Lestibonidois, Annal. de Scienc. Nat., vol. xiv. p. 267. The editors of the Annales state, that this paper constitutes a part of a Memoir d. l. Soc. Roy. d. Scienc. de l'Agricult., et d. Arts de Lille, pro 1839, the great extent of which, however, renders it impossible to communicate every thing of novelty and importance in it; and many illustrations would likewise be necessary for that purpose; and they have, therefore, contented themselves, by giving the "resumé général" at the end. The author commences with the elementary constituents of plants. The first elements of the organs, are the small globules, which are found in the elaborated sap, and which seem to possess a peculiar life. When more developed, they constitute globuline, starch, &c. They form lamellæ by their union, which together form the lamellary tissue (tissu lamellaire) that constitutes the basis of the plant. This tissue exhibits itself under a double form. The cellular tissue (t. utriculaire), and the vascular tissue (t. vasculaire). The cellular tissue consists of vesicles, or small sacs, which adhere to each other. These sacs are hexagonal, round, or oblong, flattened or spiral formed (*Cucurbita pepo.*), ramified (*Ficus elastica*), &c., &c. They either have simple walls, or are covered, internally, with free spiral formed twisted fibres (lames), or the fibres are combined (soudées), and form slits (utr. scalariformes), or they form large and narrow holes, which are regularly or irregularly distributed (utr. poreuses). Further, they are, when developed, empty, as in the pith (aréolaires), or full of juice (succulentes), or they contain a coloured juice, which thickens, and renders the walls thicker (utr. parenchymateuses). The vessels are of a twofold kind;—1st, Proper vessels or bark-vessels, which carry a more or less coloured juice: 2d, Tracheæ, central, or wood-vessels. The tracheæ have a fibre in the interior, which lies close to their walls; this fibre is free, twisted in a spiral form, and may be unrolled in the true tracheæ, or it is double, either with edges that are remote from, or touch each other; or the edges are here and there entwined with the false tracheæ, or with the cranny like vessels (v. fendus); or they are intergrown with each other, in a manifold manner, as in the porous vessels. The tracheæ sometimes consist of small pieces, which are joined to each other at their ends (v. articulés). These different forms are frequently found together in one and the same vessel, but one form never changes itself into another. *Dicotyledons.*—The stems of *Dicotyledons*, at the commencement of their formation, are formed of a transparent, juicy, imperfectly developed organized cellular tissue. They soon exhibit more juicy and coloured points, which in definite numbers constitute the parenchymatous bundles. These bundles contain vessels of a twofold kind;—1st, Proper vessels, which are placed towards the circumference, and especially towards the external circumference: 2d, Tracheæ, which are situated in the interior of the bundles. The parenchymatous bundles are situated in the pith of the stem, and are divided into three parts, the central pith, the medullary rays, and the bark. The first period of growth follows. A transparent intervening space exhibits itself between the two vascular groups of the parenchymatous bundles, which is only an exhaled cambium (exhalé), with an imperfect organization. This gelatinous zone soon organizes itself, and becomes parenchyma, in which new tracheæ are situated on the external, and new proper vessels on the internal side of the older vessels, and between them a new gelatinous intervening space is formed. An analogous growth also takes place in the medullary rays. Some vessels remain stationary at the first period of their growth, their vascular bundles are always round; the gelatinous intervening space of the bundles becomes solid, and thus also the analogous intervening space in the pith forms rays. In the second period the parenchymatous bundles are lengthened through the external part of their central portion, and through the internal part of their bark portion; these growing portions also spread laterally. By this the central portion of the bundle becomes triangular, and strives to effect a combination with the adjacent bundle. The cellular intervening spaces of the bundles, which are situated between the vascular masses, correspond with the intervening spaces of the other bundles, and in this way the medullary layers (circonferences medullaires) are formed, which, however, do not always fit exactly one upon another. The new vascular groups do not, however, attach themselves immediately to the old, but there is almost always a separating cellular tissue between them. This is very easily to be distinguished in the roots of the beet. The bundles meet at the end of the first year, and thus is produced the first annual ring. New transparent layers are produced between the wood and bark in the third and fourth period of the growth, from an exhaled cambium; new vascular fibres are produced in the parts which belong to the central system, and are separated by medullary layers and medullary rays, which are either continuations of the preceding year, or new formed ones. At last, the internal layers of wood, and the external layers of bark, become dense and hard. The root of the *Dicotyledons* is similarly formed to the stem; and although the pith does not appear in many roots, it yet penetrates into it, gradually decreasing. Of the leaves the author says, that the position of the leaves on the stem have hitherto alone been investigated, without seeking for their derivation in the position of the bundles of the stem; he carries this out by contemplating the opposite, whirled and alternate, leaves. The buds he distinguishes into terminal buds and lateral buds; the former are only the end of the stem, which is connected with the transparent growing zone, and consequently can go on developing; the latter are formed by a prolongation of a part of the parenchyma of a median bundle, which is carried away by the pressing forward of the leaf-fibre. The blossoms he contemplates in the same manner as the leaves, and says, that the symmetry of the alternate leaves is most frequently that of the parts of the flower, and that five parts present themselves in the blossom, as five leaves most frequently do in a single turn of a stem. *Monocotyledons.*—The author lays particular stress upon the doctrine, that there is no difference between the stem of the *Monocotyledons* and annual plants, the growth of which is limited, in as far as the bundles are rounded, and remain isolated; as the transparent part also does not develop itself, but becomes more dense, or disappears, so that no separation takes place between the central and bark portions. The growth takes place in the following manner:—The new fibres are produced from the external fibres, and also from those which constitute the denser part of the stem; and further, from those which are situated near the pith. The result of the growth, therefore, does not occupy any particular zone; it takes place through the whole thickness of the trunk, and is therefore no larger on the outside than on the inside.

The researches of the author deserve every attention, and many points have been illustrated in an admirable manner. That the granules, which are situated in the sap, should form cells by their union, is a mere hypothesis, which lacks all probability. What the author says of the vessels is very correct in general; but it is strange, that he mistakes the liber and the prosenchyma for proper vessels. For it is evident, from his description of the woody bundles, that he means that tissue when he speaks of proper vessels. The latter are distinguished by their great diameter; and although they contain no coloured juice, there are yet granules in the juice, which render them very distinct. Nothing of the kind is seen in the liber tissue, and still less in the cells of prosenchyma. The proper vessels are likewise of much rarer occurrence in plants than the two tissues alluded to. The cellular tissue is perfectly organized, even in the earliest state; and it is always owing to the want of a good microscope, if it does not appear organized in the phanerogamia. He has correctly explained how the central part developes itself in the woody bundles, which he calls, against all the usages of language, "faisceaux parenchymateux;" but every thing is not accomplished by this alone. If the author asserts, that the root is not different from the stem, he must have overlooked the circumstance, that the pith is wanting in most roots, or, when it does exist, that it wedges itself towards the apex; and that, on the contrary, the pith increases towards the apex of the trunk. The reference to the fibres of the stem, for the representation of the position of the leaves, does not appear to me of importance; and his idea of the formation of the bud seems quite erroneous. With respect to the *Monocotyledons*, the author overlooks the circumstance, that there is not a series of woody bundles existing in them, as in the *Dicotyledons*, and that evidently some of them are produced at a later period, which alters the matter altogether.